



## JOURNAL

NOV.

1892.

OF THE

# MILITARY SERVICE INSTITUTION

WILLIAM L. HASKIN,  
Editor First Part.

Authors alone are re-  
sponsible for opinions  
published in the Journal.

JAMES C. BUSH,  
Editor Second Part.

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## COMFORT FOR OUR ADVERTISING MAN.

Our advertising department is now and then brightened by a rift in the clouds of care, and gleams of sunshine come when least expected. A day or two ago the mail brought us this note.

"DEAR SIR :

TROY, N. Y.

Enclosed find three very attractive advertising verses. There is nothing that draws the attention of a reader so quickly to an advertisement as a little verse. If accepted, please send their price, \$1.00 to — "

Worth One Dollar? We should say so! But our lady friends shall judge for themselves. Here is the first stanza :

- (1.) "As Housewives one and all agree,  
'Ferris' Hams are known to be  
Unexcelled in quality."

It was intended that the verses should be issued one at a time, but as we are rather generous in our disposition, we have concluded to give the House-keepers of the Nation the whole poem at once. The Muse runs on as follows :

- (2.) "You should know as others do,  
That 'Ferris' Hams, and Bacon too,  
Grace the very best menu."

Evidently all is smooth and forceful thus far. We launch out the third verse with a little trepidation, but here it is :

- (3.) "'Ferris' Hams are far the best,  
In every way, by every test,  
As those who use them will attest."

"Test" and "attest" (?). Is not that rhyme slightly open to criticism? It strikes us our poet could have written,

"Use them and you will be at rest."

(i.e., on the question of their excellence), or his exhortation might have turned as follows,

"Be sure you find them in your quest,"

or, with a practical turn, how would this have done?

"You need not fear they'll indigest."

But here we must leave poetic criticism. Our "Advertising Man" feels he has found an ally, indeed, and with the help of the poet from Troy, hopes now to be able to touch the hearts of the House-keepers of America as never before by the merits of the "**Ferris**" Famous Hams and Bacon.





# The Norddeutscher Lloyd S. S. Co.

SHORT ROUTE TO LONDON AND THE CONTINENT

THE COMPANY'S FLEET OF  
FAST EXPRESS STEAMERS ON THE NEW YORK LINE.

Consists of the following Magnificent Steamships,  
*Spre, Havel, Kaiser William II, Lahn, Aller, Snahe, Elder, Ems, Werra,  
Trave, Fulda, Elbe.*

Of 5000 to 9000 Tons and 8000 to 18,000 Horse-Power.

The Norddeutscher Lloyd Steamship Company maintain a service twice a week between New York, Southampton and Bremen. Extra sailings during the travelling season.

Steamers leave New York every Wednesday and Saturday and land passengers at Southampton in less than 7½ days after leaving New York.

**L**ONDON is reached from Southampton by rail in about 2 hours by Special Norddeutscher Lloyd Trains and cars. Trains leave and arrive at the Waterloo station in London.

After landing passengers, mail and specie at Southampton, the steamers proceed at once without further delay to Bremerhaven, (the harbor of the Norddeutscher Lloyd fleet). The trip occupies about 34 hours.

Passengers are transferred to the railway train in waiting on the quay at Bremerhaven and reach Bremen 1½ hours from Bremerhaven.

**B**REMEN is a railway centre in frequent and direct communication with the interior of Germany, Switzerland, Austria, etc.

**P**ARIS can be reached by London & South-western Railway Co.'s steamers from Southampton to Havre.

The staterooms on these steamers are large and comfortable, the saloons, ladies' cabins and smoking-rooms beautifully furnished and decorated, and the cuisine equal to that of the best Continental Hotels. The galleys and kitchens are on deck, and the pantries immediately beneath them, connected by elevators, thus successfully preventing any kitchen odors from entering the saloon or staterooms. The steamers are commanded by experienced officers, who are picked men.

There is no overcrowding on this line. Number of passengers limited to seating capacity.

Apply to OELRICHS & CO., 2 Bowling Green.

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## ✻ CARPETINGS. ✻

All Grades and Styles are shown in our stock in such variety that suitable designs and colorings can always be secured.

We solicit particular attention to our large display of

## FOREIGN & DOMESTIC RUGS & MATS

in all sizes, and the

## SLOANE CENTRAL CARPET

especially desirable when it is not intended to cover the entire floor.

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## UPHOLSTERY GOODS and LACE CURTAINS.

The great variety shown in these Departments affords unusual opportunities for securing rich and artistic decorative effects; it also includes an extensive line of simple and inexpensive fabrics in the latest high art designs.

Samples and suggestions by mail. Mail orders have our prompt attention.

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18th & 19th Sts.,

# Pears' Soap

Pears' Soap is nothing but Soap—no medicine in it—pure soap. And yet—but read what a great authority says of it:

I have tried very many different soaps, including all the best known, whether English or foreign, pursuing my investigations with perfect independence; and I have now, after all these years of careful observation in very many thousands of cases, both in hospital and private practice, no hesitation in stating that *none have answered so well or proved so beneficial to the skin as Pears' Soap*, an experience

not only endorsed in their works on the skin by the late Sir Erasmus Wilson and Dr. Tilbury Fox, but vouched for by such eminent analytical chemists as Professors Redwood, Attfield, Cameron, and others. . . . Time and more extended trials have only served to ratify this opinion, and to increase my confidence in this admirable preparation.—*Milton's Hygiene of the Skin*, p. 90. (ed. 1891.)

It has no alkali in it—nothing but soap.

The more purely negative soap is, the nearer does it approach to perfection.

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HORSTMANN BROS. & CO.,

*Fifth and Cherry Streets,*

PHILADELPHIA,

MANUFACTURERS OF

## MILITARY EQUIPMENTS.

Officers' Outfits a Specialty.

Our New Illustrated Catalogue and Price List  
is now ready.

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Indispensable to parties residing out of town, and acknowledged the most complete Shopping Guide published. It contains over 2,000 handsome Woodcuts and Lithographs illustrating the latest Styles and Fashions.

Every article guaranteed as represented, or the money will be refunded. Read our extraordinary offer, "How to receive Goods free of Express Charges."



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Send in your name AT ONCE (mentioning this Journal) as the Edition is limited.

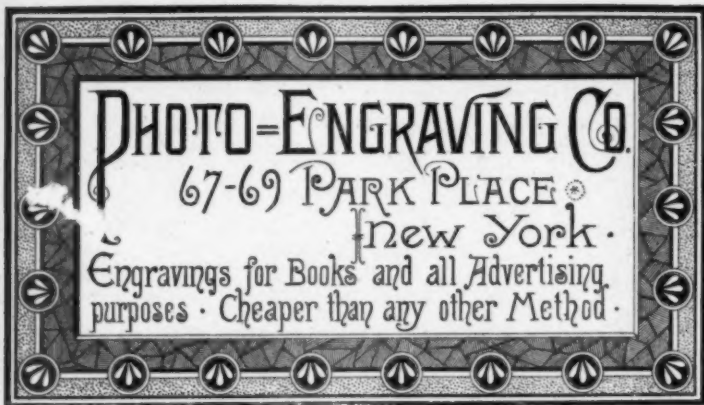
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Importers and Retailers of DRY & FANCY GOODS, MILLINERY, CLOTHING, SHOES, &c.

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Between Lenox & 7th Aves.

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several departments of engraving, and printing, it is able to compete with any concern in the business.

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**D. HIRSCH & COMPANY, 331-333 Bowery, New York.**

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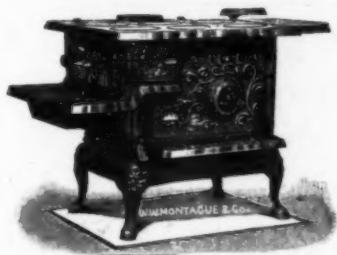
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Is the thinnest ground Razor made, and  
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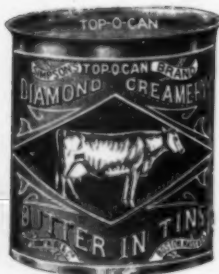
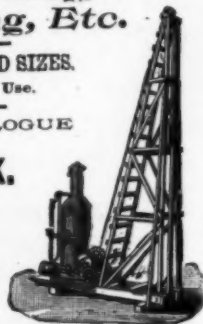
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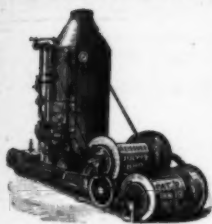
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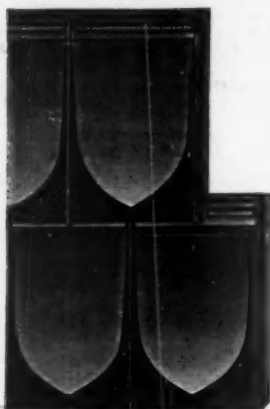
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SPECIAL ATTENTION GIVEN TO GOVERNMENT CONTRACTS.

Catalogue on application to SMITH & WESSON, Springfield, Mass.





ESTABLISHED 1848.

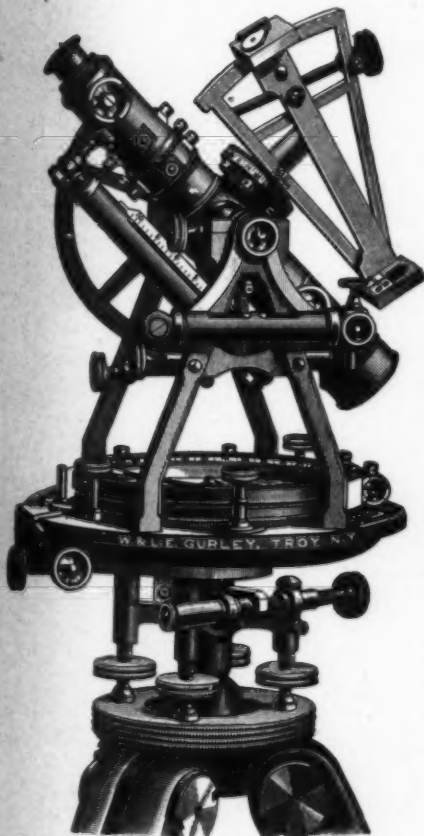
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### VON BÜLOW'S LETTER, After Concert Tour, 1890.

To WM. KNABE, Esq.,  
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*With sincere regards,  
Yours truly,  
DR. HANS VON BÜLOW.  
Hamburg, 27th May, 1890.*

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the World's Greatest  
Pianists:

## Von Bülow

—AND—

## D'Albort

Both  
declare the Knabe  
the Best Pianos  
in America.

### Eugen D'Albort's Letter

—TO—

WM. KNABE & CO.

Translated from the German.

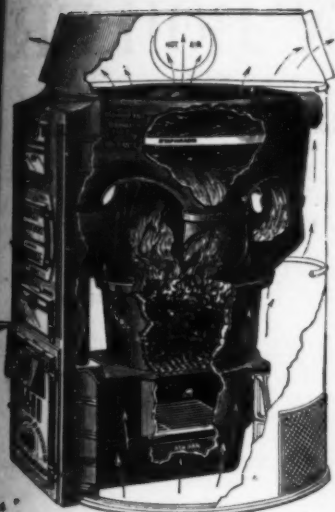
*During my sojourn here I had frequent opportunities to make myself acquainted with the Knabe Pianos, and from fullest conviction I declare them to be the best instruments of America. Should I return here for artistic purposes—which may be the case very soon—I shall most certainly use the Pianos of this celebrated make. I give this testimonial with pleasure, voluntarily, and entirely unsolicited for by the house of Knabe.*

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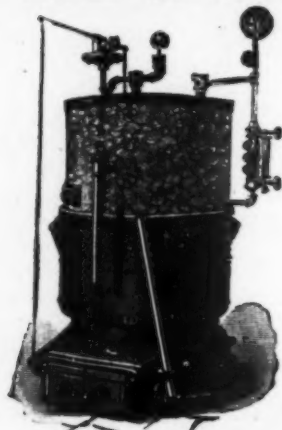
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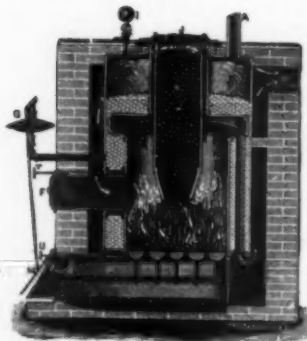
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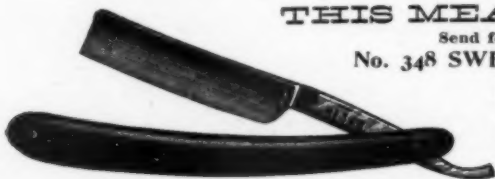
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DETRINE,	2.4	FATTY SUBSTANCES,	2.6
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*"I cannot help plead to my countrymen, at every opportunity, to cherish all that is manly and noble in the military profession, because Peace is enervating and no man is wise enough to foretell when soldiers may be in demand again."*—SHERMAN.

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VOL. XIII.

NOVEMBER, 1892.

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NO. LX.

GUNS AND FORTS.

BY LIEUTENANT-COLONEL WM. R. KING, U. S. ENGINEER CORPS.

ONE of the first things to be considered in any attempt to design fortifications is the nature and power of guns that may be brought against them. It is not sufficient that we know what guns are now existing but, as several years must elapse before any system of fortification can be built and probably many more before they are attacked, it is evident that the question involves something of prediction as well as study of ordnance statistics.

In all ages and countries there has been a disposition to increase the magnitude of various structures and devices far beyond practical and useful limits—for example, the Pyramids of Egypt, the Colossus of Rhodes, and the Chinese Wall were mere enormities, while the Great Bell of Moscow, the steamship *Great Eastern* and the Graphic Balloon, were all too large to be of any practical use.

Not only is this true, but there is a natural propensity to magnify things that are already large or wonderful, which has had a tendency to produce exaggerated notions of the possibilities of gun construction and, as in case of electricity, people have become so accustomed to the enormous strides of invention, that they are not only prepared to accept almost any claim that is made by in-

ventors, but to discount the most visionary schemes that are suggested.

Let it be announced that Krupp or Armstrong has started to build a 500 ton gun, or one that would sink a ship at 20 miles range, and a large proportion of the intelligent reading public will accept the statement as a matter of course, and only wonder that such guns have not been made before. In fact it is more than probable that many educated people were unable to see anything so very preposterous in Jules Verne's 9-foot Columbiad that sent a shell around the moon.

Even among army officers, who are supposed to give special thought to the subject, the difficulties in the way of any great increase in the calibre of guns are seldom appreciated and modern rifles of 16, 18 and even 20 inches calibre are spoken of as facts easily attainable if not already accomplished.

From the intimate relation between guns and forts this uncertainty as to what gun power may be developed in the near future has not only tended to keep the public mind in a state of doubt as to what forts if any may be safely relied on, but to keep the whole subject of fortification in an experimental stage for many years and prevent any serious effort to furnish the means for carrying out a systematic plan of fortification.

It is not proposed in this paper to enter into any discussion of the details of gun-making, or of the relative merits of different materials or methods of construction, but only to consider some of the elements on which the possibilities of increased power depend.

For historical details and statistics of guns already made and of the methods of construction, reference may be had to the comprehensive work of the late A. L. Holley, and for more recent information to the excellent monograph of Captain Rogers Birnie, U. S. Ordnance Corps, published by the Military Service Institution, and translations of lectures of Col. Pashkievitch, by Lieut. Tasker H. Bliss, A. D. C.

Great promises have been made from time to time as to the increase in calibre of guns, and the public has been led to believe that at least a portion of these promises have been fulfilled; but, strictly speaking, there has been no increase either in the calibre or in the length of guns during the past two centuries. On the contrary nothing has recently been attempted that would nearly equal the enormous guns built in India, Turkey and Russia, unless

we accept the 36-inch "mortar" built by Mr. Mallet of England, and even this monster, which carried a shell weighing 3000 pounds, was built thirty-five years ago.

In fact the rifled mortar and the quick firing gun, that for the past few years have monopolized a large share of attention, were the work of a former generation.

The real progress made has been in the increase of the power of guns by improvements in powder and in the materials and workmanship of the guns and projectiles.

The power and endurance of guns of any given form, size, or materials can only be safely determined by the actual trial of one or more of them with *service charges* and *projectiles*; but we may in the absence of such trials study the elements upon which the stresses and strength of guns depend and with reasonable certainty predict the life and power of one gun from the relations it bears to other guns that have been thoroughly tested; just as the safety and capacity of a proposed steam engine may be calculated from data furnished by engines actually in use, though of different dimensions. In case of the guns, however, the nature and relations of the forces and resistances are much more complex and difficult to measure, especially if we attempt to compare guns of very different sizes, or rifled guns with smooth bores, and the object of this discussion is to analyze these relations and present them if possible in such a manner as to show at a glance what difficulties are in the way of the further increase in the calibre of guns; and the direction, if any, in which their power may be safely increased.

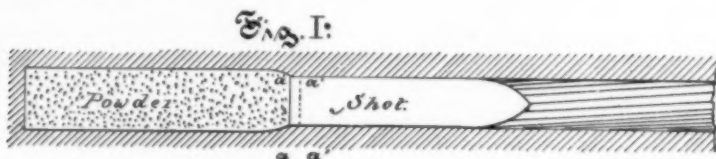
Under normal conditions the stresses to which a gun is subject depend upon its *calibre*, the *weight of powder*, *rate of combustion*, *size of powder chamber*, *weight of projectile* and *pitch of rifling*. These six elements are so related that either may be changed without changing any of the others, or two or more of them may be changed so that the changes will neutralize each other and produce no change in the stress upon the gun. In short they are independent variables.

We will assume, for the present, that in all cases the *same kind of powder* is used in the different guns: that the *charge is no larger than will be completely "inflamed"* before the instant of greatest pressure; and that the *rate of "combustion"* is *not materially affected* either by the *size of the charge* or by the *pressure* it develops. Also that the soft metal bands that take the grooves

are such as not to produce undue or variable resistances to the motion of the projectile.

While these conditions are not, strictly speaking, to be met with in practice, it should be borne in mind that all physical investigations require just such premises, and that without them no application of mathematics to physical problems would be possible; the sun is not at the centre of the solar system and the planets do not move in elliptical orbits, but the assumption of these conditions was the basis of our present knowledge of astronomy.

Let Figure "I" represent a section through the axis of any loaded gun whatever, either rifled or smooth bore, plain or chambered, the projectile being of any form or material that will not wedge or break in the gun.



At the instant of firing, and before the shot begins to move, enough gas must be generated to fill all the interstices in and around the charge and to develop a pressure greater than the friction of the shot in the bore. No matter how large the chamber may be the gas can only find exit by moving along from  $a$  to  $a'$  in the bore of the gun. It is evident on a moment's reflection that the number of atoms seeking to pass the section  $[a a']$  will, within reasonable limits, be independent of the form of the charge, and for present purposes we may consider it as reduced to a cylinder of the diameter of the bore of the gun.

It is also evident that the shot acts to increase the pressure in the gun, only by its mass, and that this effect would not be changed by reducing it to a cylinder that would just fill a section of the bore. The question of windage is not material at this point, but we must consider the mass of the projectile as being increased by one-fourth of the mass of the powder itself, since the centre of gravity of the charge will evidently move one-half as fast as the projectile, one end of the column of inflamed powder remaining practically stationary at the bottom of the bore while the other follows and remains in contact with the base of the shot until it leaves the gun. One-fourth of the mass  $\times$  square of the

velocity of the shot = the mass  $\times$  the square of  $\frac{1}{2}$  the same velocity. This effect of mass of powder is shown by the recoil of guns fired with blank charges.

These reductions can be made as follows :

Let  $P$  = The weight of powder in pounds.

$S$  = The weight of shot in pounds.

$C$  = Calibre of the gun in inches.

33 cu. inches of powder = 1 pound. 3.84 cu. inches of cast-iron = 1 pound.

Then : Eq. [1],  $42.02 \frac{P}{C^3}$  = the reduced length of the charge.

And : Eq. [2],  $4.89 \left[ \frac{S + \frac{1}{4}P}{C^3} \right]$  = the reduced length of shot, in-

cluding in this expression one-fourth of the weight of the powder which, without affecting the final result, may be reduced to the same density as the shot.

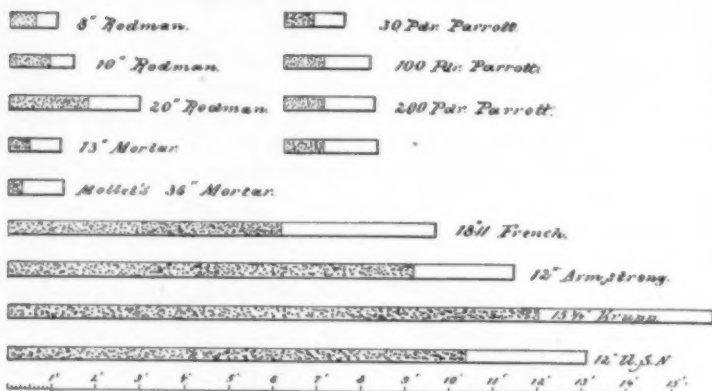
With shot and charge thus reduced to cylinders conceive the bore of the gun to be divided into parallel tubes, like the cells of a honeycomb, each tube having a base equal to one square inch. It is evident that in seeking an outlet, the powder will have no tendency to pass from one of these imaginary tubes to another and as each of the tubes will contain the same quantity of powder and of iron, the columns of powder and of iron in any one tube will be independent of the number of tubes or in other words the pressure in one of these tubes containing the reduced length of powder and shot will be a measure of the two quantities upon which the pressure, per square inch, in the bore of the gun depends, *without regard to the size of the gun or form of projectile.*

We may then, from the known weights of powder and shot in guns of different calibres, prepare a table of reduced lengths of charge and projectile which will give data for a relative measure of the pressure in the bores of the guns.

From equations 1 and 2, we find the following reduced lengths of powder and shot in some of the well-known service guns of different periods. (See Fig. 2 next page.)

Taking the 8-inch Rodman or the 30 pdr. Parrott gun as a unit we can form some idea of the enormous duty required of modern guns. It will be noticed that the 40 C. M. Krupp for example has a powder column more than 20 times as long as the 8-inch Rodman. It is hardly probable that any gun-maker would undertake to build a gun of one inch calibre to be loaded with 12

## END. II.



feet of powder and four feet of shot, but it would for obvious reasons be easier to make such a gun than build one of 16 inches calibre for the same column of powder and shot.

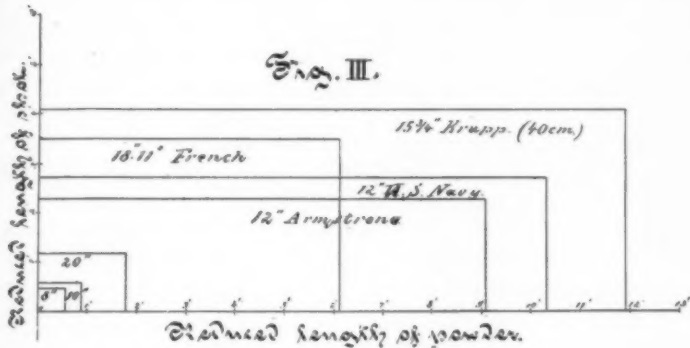
In case of the rifled guns an addition of a certain per cent. to the weight of the shot should be made to compensate for cutting off windage, which makes a very considerable reduction of pressure in smooth bores, and for the friction of the expanding ring of soft metal and work done in generating the rotary motion. This will be further discussed later on.

Having obtained the reduced lengths of shot and charge as already explained, the question arises how should these results be combined so as to give an accurate relative measure of the pressures per square inch?

To reason from extreme cases we can see at once that if *no* powder is used there will be no pressure developed. We also know that for ordinary charges the work stored in the shot is nearly proportional to the weight of the charge. The travel of the shot being practically the same, the mean pressure must therefore vary with the weight and reduced length of the charge.

It is also apparent, from a similar course of reasoning, that the pressure ought to increase directly with the column of metal or reduced length of projectile (including one-fourth of the powder as already explained) and we may therefore conclude that the reduced lengths of powder and shot ought to be used as factors and multiplied together to give the relative pressures.

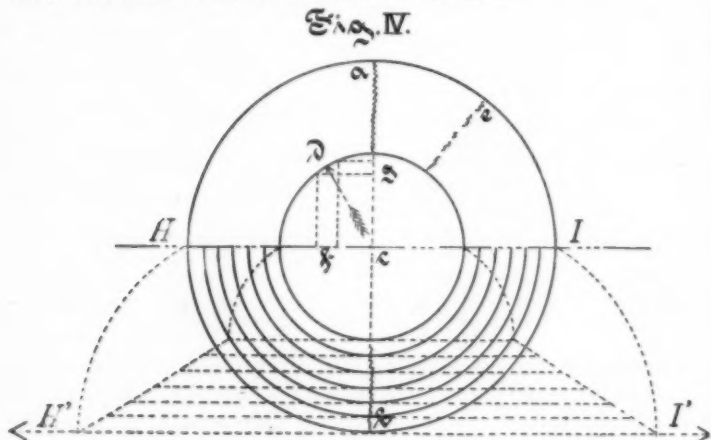
If then we lay off horizontal lines equal to the reduced length of powder charge and vertical lines equal to the reduced lengths of shot, we may construct a series of rectangles whose areas will correctly represent the relative pressures per square inch in different guns, subject of course to the conditions assumed at the outset.



From this diagram we may form some idea of the enormous pressures to which the larger guns would be subject if loaded with the same kind of powder as the 8-inch smooth bore for example, and it is also apparent that the excessive pressure in the 12-inch Armstrong is due to excessive length of powder column, while the French [Ruelle] gun has an excess of both powder and shot. In fact I felt justified many years ago in predicting that the Ruelle gun and probably the Armstrong too would never endure many charges of the size intended for them, and the results have fully confirmed this prediction, as the guns in question were promptly sent to the scrap heap. The use of the slower burning powder and allowing more space in which the gas can expand before the instant of maximum pressure, have been the means resorted to for toning down the enormous pressures; but these causes would not have made even the medium calibres of guns possible but for the great increase in the strength of materials used in gun construction, and the provisions adopted for securing proper initial tension.

But before proceeding further with this branch of the subject we must introduce another factor in measuring the stress upon the gun, viz.: The number of square inches upon which the pressure we have arrived at acts in its effort to burst the gun.

By reference to Figure IV, it will be noticed that the stress upon the gun is greatest in a plane  $a, b$ , through the axis of the bore, since the pressure is exerted upon each half circle in opposite directions, but if fracture should take place in any other line as  $b, c$ , there would be less than a semi-circle on one side, which amounts to saying that the rupturing pressure would be that much less than in case of the meridian section.



If now we consider the pressure upon any small portion of surface as  $[d]$  it is evident that the normal pressure upon this elementary surface may be resolved into two components one of which will exert a pressure at right angles to the supposed plane of rupture  $a, b$ , represented by the projection  $[g]$  of the elementary surface upon that plane and all the widths of all these elementary surfaces together projected upon this plane would just equal the diameter of the bore and for each unit of length, say one inch of bore, the pressure tending to burst the gun will be equal to the pressure per square inch multiplied by the diameter of the bore  $[C]$ , which in this case must be measured in the powder chamber, if it be larger than the bore, since the maximum stress is to be provided against. We may then complete the calculation by multiplying the product of the reduced lengths of shot and powder [equations 1 and 2] by the diameter of the chamber in each case, which gives:

$$\text{Eq. [3], } 42.02 \frac{P}{C^3} \times 4.89 \frac{S+1P}{C^2} \times C = 205.48 \frac{P.S.+1P^2}{C^2} \times C =$$

total bursting pressure per unit length of bore.

If the powder chamber is no larger than the bore, this expression reduces to  $205.48 \frac{P.S. + \frac{1}{2}P^2}{C^3}$ , from which it appears that with a given weight of powder and shot in different guns the bursting pressure per unit length of the gun will be inversely as the cubes of the calibres. This amounts to saying that if we wish to throw a given weight of projectile, propelled by a given charge, the larger the gun the safer it will be, and this accords with Gen. Rodman's principle in advocating smooth bore guns of large calibre, viz.: that he could throw the greatest weight of metal with greatest charges in a given time and for a given cost.

These considerations are of course subordinate to considerations of range, accuracy of fire and penetration of armor.

If we assume a series of guns and charges whose proportions are similar geometrically, the weight of powder and shot may be represented by constants  $P$  &  $S$ , multiplied by the cube of the calibre, thus  $P = pC$  and  $S = sC$  which substituted in Eq. 3 reduces to  $205.48 [p.s. + \frac{p^2}{4}] C^3$ .

This shows that in similar guns similarly loaded the bursting pressure per unit length of bore will be directly proportional to the cubes of the calibres.

The relations between the total pressures per unit length of bore for a number of well-known guns are shown in the last column of the table on next page:

#### LOGARITHMIC FORMULÆ.

Log. reduced length of shot =  $.689241 + \log. (W + \frac{1}{4}P) - 2 \log. C$ .

Log. reduced length of pdr. =  $1.623424 + 10 \log. P - 2 \log. C$ .

In comparing these figures it must not be forgotten that they are based on the assumption that the guns are loaded with the same kind of powder, and it is quite evident that if some of them had been so loaded they would never have fired a second round. Even with the larger grained, slower burning powder, many of these guns have been sent to the scrap heap, as will appear further on.

In what has preceded the circumferential stresses alone have been considered, the longitudinal and torsional stresses being relatively small and easily provided for. The former of these is equal to the maximum pressure, per square inch, of the powder gas, multiplied by the area of the bottom of the bore, and this

TABLE I.

Kind of Ordnance.	W = Weight of Shot.	P = Weight of Powder.	W + $\frac{1}{2}$ P	$\frac{1}{2} \pi C^2 =$ Area of Bore.	Reduced length of Powder.	Reduced length of Shot.	Reduced Powder. $\times$ Reduced Shot.	The last Product. $\times$ Diameter of Bore.	Diam. of chamber where larger than bore.
8-inch Rodman .....	65	10	67.5	50.25	6.6	5.16	34.04	272.34	
10-inch Rodman .....	128	25	134.25	78.54	10.5	6.56	68.92	689.22	
12-inch rifle, Rodman .....	620	70	637.5	113.1	20.4	21.64	441.55	5208.57	
13-inch mortar, .....	282	20	287.	132.8	5.0	8.3	41.51	539.63	
15-inch Rodman .....	450	100	475.	176.7	18.7	10.32	192.98	2894.76	
20-inch Rodman .....	1070	200	1120	314.1	21.0	13.69	287.49	5749.8	
30-pdr. Parrott, 3.67 .....	191	2.	20.	.....	6.2	7.26	45.01	105.04	
30-pdr. Parrott, 4.2 .....	29	3 $\frac{1}{2}$	29.81	.....	7.7	8.30	63.91	268.42	
100-pdr. Parrott, 6.4 .....	100	10	102.5	32	10.3	12.47	128.4	821.76	
8-inch Parrott .....	175	16	179	50.25	10.5	13.67	143.53	1148.28	
10-inch Parrott .....	300	25	306.25	78.54	10.5	14.88	156.24	1562.4	
9-inch rifle .....	330	50	342.5	63.6	25.9	20.65	534.83	4813.51	
11.8-inch [Woolwich] .....	700	130	732.5	105	40.9	26.81	1096.52	12719.74	
13.3 " .....	580	100	605	.....	22.6	16.71	377.65	5022.74	
36-inch mortar .....	3000	100	3025	.....	3.24	11.42	37.	1332.	
94-inch Krupp .....	297.5	52.9	310.7	67.2	26	17.75	461.5	4268.87	
11-inch Krupp .....	496	88.	518	95.	30.6	20.91	639.85	7038.31	
14-inch Krupp .....	1212	130	1244.5	154	27.9	31	864.9	12108.6	
Tons.									
16.11 B. L. French .....	2645	575	2788.75	257.6	73.7	41.6	3064.92	55505.7	
18.1 B. L. Italian .....	2200	440	2310	257.3	61.4	34.46	1943.54	36149.84	
17.72 M. L. Armstrong .....	2010	463	2125.75	246.6	51.5	32.91	2023.96	39872.01	19.7
16.7 M. L. Woolwich .....	1760	460	1875	261.1	75.5	35.81	2703.7	48666.6	18.
15.75 B. L. Krupp .....	1711	484	1832	194.8	81.94	36.13	2660.75	51280.23	17.32
12.7 B. L. Woolwich .....	700	312	778	113.1	91.0	26.41	2403.5	37254.17	15.5
12.7 B. L. Armstrong .....	700	375	794	113.1	109.4	26.94	2047.67	42151.8	14.5
17.72 Eng. M. L. .....	2000	450	2112.5	.....	60.22	32.80	1981.15	39028.8	19.7
16.25 Eng. M. L. .....	1800	850	2012.5	.....	135.22	37.26	5039.74	106439.32	21.12
16.63 French model .....	1720	850	1869	.....	89.61	33.52	3003.91	49956.11	
15.75 Krupp [Italy] .....	2205	595	2416.6	.....	143.35	47.63	6829.25	123650.	18.11
17. Armstrong [Italy] .....	2000	900.0	2225.	.....	130.85	37.64	4925.4	83732.	
12. Russian .....	732	247.	794	.....	72.07	26.96	1042.95	23115.	
12. U. S. Navy .....	850	425.	956.	.....	124.0	32.46	4025.2	58367.	14.5

force divided by the area of cross-section of metal at the base of the bore, will give the tensile stress, parallel to the axis, per square inch of metal.

The torsional stress occurs only in rifled guns and depends upon the pitch of the grooves as well as upon the calibre, weight of projectile, etc. In case of an increasing pitch the maximum stress will occur long after the shot has passed the point where the other stresses are at their maximum intensity, and it will not therefore assist them materially in bursting the gun.

Having investigated the relative stresses to which guns of various calibres are subject, we will proceed to inquire briefly into the manner in which these bursting forces are resisted, and the means by which the strength and endurance of guns may be increased.

In general terms the means of increasing the strength of guns are: 1st. Increasing the thickness of metal, 2d. Using stronger metal, and 3d. Providing for proper "initial tension."

In regard to the first of these we may suppose a gun to be built up of thin concentric tubes, fitting into each other, but not so tightly as to produce enlargement or compression of each other, and assuming for simplicity that the thickness of metal in the gun is equal to half its calibre, we may construct the diagram shown on lower half of Fig. IV, representing a section of such a gun.

Now let the gun be burst in the plane A B and let the sections of the tubes be developed into straight lines, the quadrant b I becoming a straight line b I'. The rupturing stress of the outer cylinder will be represented by the arrows at H' and I', and if we assume the metal to be incompressible, the elongation of any elementary cylinder or its developed section, will be the same as that of any other cylinder, but as will be seen by inspection the lengths of these elementary sections vary from about one and one-half times the calibre for the inner one to three times the calibre for the outer one, or in other words if the metal is only strained within the elastic limit, the stress upon each cylinder will be proportional to its elongation, and the stress upon the outside element will necessarily be only one-half of that on the inner tube. If we assume the metal to be compressible, which is the true state of the case, the stress on the inner tube becomes still greater and the intermediate ones are intermediately strained. When the inner tube arrives at its breaking stress the outer one

would therefore be under less than one-half of its breaking strength.

But at this point comes in another force that has heretofore been omitted from such calculations. We may recall the fact that in resolving the radial bursting force of the power into two components, we omitted one of these components which, being parallel to the plane of rupture, could not exert any influence on the bursting force at right angles to that plane.

This component however must be reckoned with and, without going into any mathematical calculation, it may be seen from inspection, that it exerts a compression upon the inner tube at the point of rupture, equal to the full bursting pressure of the powder gas, or say fifteen tons per square inch. The effect of this compressive force is to assist in the rupture of the metal already under tensile stress, just as a strip of rubber sustaining a weight, may be elongated by compressing it between the thumb and finger, or as a bar of iron becomes elongated by rolling or hammering. The compression is greatest at the surface of the bore where the metal is already under the greatest tension, and gradually decreases outward until it becomes zero at the exterior surface of the gun.

Authorities differ somewhat as to the relative value of concentric rings of metal in resisting internal pressure, some placing the loss of strength in homogeneous cylinders as high as the inverse square of the distance from the axis of the bore, but all agree that the loss is very rapid and that beyond a certain limited thickness no additional strength is gained by increasing the quantity of metal, and that "no possible thickness can enable a homogeneous cylinder to bear a pressure from within greater per square inch than the tensile strength of a square inch of the metal." \*

But all this relates to bursting of cylinders by steady pressures and when we come to consider sudden or impulsive forces the loss of efficiency of the outer rings of metal is still greater—in fact the suddenness of the rupturing force may be so great that the inner rings of the tube are ruptured before the molecular disturbance reaches the outer ones, and hence the latter can render no assistance whatever to the metal first acted upon.

The advantages of proper initial tension are here apparent,

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\* "It has been found that cylinders for hydraulic presses of a thickness equal to half the diameter of the piston are nearly as strong as if ten times as thick."

but it is not proposed to go into any discussion of this branch of the subject.

Notwithstanding all the modern improvements in metallurgy and gun-making, the unpleasant fact still remains that there are as many guns burst now as there were thirty or forty years ago. Even in the gun factories of Europe where the science of built up guns was developed and carried to a high degree of perfection many years ago, we hear of guns "drooping at the muzzle" and otherwise begging to be excused from the severe duty imposed upon them. When we remember that gun-making is confined to a few great establishments, among which there is more or less rivalry and jealousy, it is not to be expected that any of them will publish their own failures, or that the records we get of these failures are complete; but nevertheless there is a long and suggestive list of guns that have failed, and the meagre records published of the trials of guns of 12-inches calibre and upwards are not sufficient to remove the suspicion that no reliable guns of these large calibres have yet been made. In former times a gun was not considered safe unless it would stand *a thousand service rounds*, and they were sometimes tested by firing a shot *twice the weight of the service projectile*, and this be it remembered related to guns of cast-iron, a metal no longer deemed fit for heavy guns, or in fact any guns, unless reinforced by a stronger metal. A 30 pdr. Parrott gun at Charleston endured over 4000 rounds. Now, we hear of heavy guns that have endured 100 rounds with some surprise. Is it not evident that the margin of safety has been seriously encroached upon? If any engineer should design a railroad bridge to carry one hundred trains before it required renewal of some vital parts, would *any* train be likely to cross it?

It is a popular notion that muzzle loading guns sometimes burst because the shot is not rammed home, or on shipboard from its having been started from its place by the rolling of the vessel.

At first sight this theory would appear fallacious, since the maximum pressure either per square inch or per linear inch of bore cannot possibly be increased by giving the powder more initial space, or in other words reducing the density of loading, but there is another element to be considered in this connection, that may account for the bursting of guns under the circumstances, viz.: The longer the section of the bore upon which the maximum pressure acts the less assistance it can receive from adjacent

metal which is not at the same instant directly subjected to the bursting strain. For example an ordinary cask, if the heads were placed near together so as to leave staves projecting, would stand a much greater pressure per square inch than if the heads were so placed that the entire length of the staves could be acted on by the internal pressure. The hoops not directly over the parts subject to direct strain in the first case, would resist bursting until the staves themselves were broken.

To take another view of the case, suppose that at the instant of maximum pressure, the powder gas occupies only two calibres, or say two feet in length of the bore. Now if the gun be so constructed that one foot of metal in front and one in rear of the charge must be burst in order to let the section directly acted on by the gas give way, then it is clear that the gun will stand about double the bursting stress per square inch, that it would if each unit length of the bore had to stand the strain independently without the aid of adjoining sections. If however the section directly acted on at the instant of maximum pressure had been four feet long, the assistance received from adjacent metal would have added but fifty per cent. to its own strength, and if six feet, only one-third of that strength—hence the pressure per square inch might have been greatly reduced in the last two cases and still the gun would be more likely to burst.

It is evident that no gun could stand the enormous pressures recorded, were it not for this fact that the metal directly acted on is greatly assisted by adjacent metal in the manner just stated. The theory that metal will stand a much greater instantaneous pressure than it will slow and steady pressure, is I think entirely inadequate to account for the fact that guns appear to withstand a greater internal pressure per square inch than the tensile strength of the metal, which can be shown to be impossible, however thick the gun may be, provided of course, that the pressure acts throughout the entire length of the barrel.

Another popular notion and one not so accordant with facts is that when guns are fired at high elevations, a great additional bursting stress is experienced. The fallacy of this theory is apparent from a moment's consideration of the quantities involved. When a gun is fired horizontally, the gas pressure is ordinarily say 30,000 pounds per square inch. Now let the gun be fired directly upward and this pressure acting on the base of the projectile will be increased by the weight of the shot per square inch

of its base, which with the heaviest loading will hardly exceed 12 pounds. The variation of pressure will therefore be only  $\pm 12$  pounds per square inch in a total pressure of 30,000 pounds, and is of course inappreciable, even when the gun is fired directly upward or downward.

The effect of the recoil upon the trunnions and upon the carriage is an entirely different matter, and this component of the force of recoil increases with the sine of the angle between the axis of the bore and the chassis. It is probable that this last effect as manifested in the damage to gun carriages and platforms has given rise to the erroneous idea that high elevations may cause the bursting of guns.

The effect of checking the recoil entirely would increase the bursting strain on the gun only about one per cent.

In addition to the causes mentioned, guns are probably burst from many accidental causes, for example:

1. The breaking or spalling off of a piece of the projectile, which forms a wedge having a larger base in proportion to its mass than the main body of the shot has, and will be driven forward with a much greater velocity than the shot. Thus producing an enormous amount of friction against the bore of the gun.

2. Where the walls of a shell are not thick enough to withstand the pressure of the gas against its base, the shell may be actually "set up" and enlarged so that the iron itself will take the grooves of the gun just as the soft metal, or expanding base does.

3. The enormous pressure of the gas may be sufficient to actually penetrate the metal of the shell, perhaps through minute flaws or invisible fissures and thus ignite the bursting charge which, in addition to the propelling charge, may be too much for the gun.

4. A handful of sand thrown into a gun after it is loaded, either by the wind or by the blast of a neighboring piece or by a projectile striking near its muzzle, might cause the metal of the shot or bore of the gun to "cut" or roll up and wedge the shot in the gun just as a few grains of sand will cause a car axle to cut the box and sometimes become red hot in a few minutes.

5. The pressure upon the bursting charge in a shell required to impart velocity to it may be sufficient to generate heat and ignite it. This pressure will depend upon the length of the column of powder in the shell and in the longer projectiles may amount to as much as a ton per square inch. This force being applied very suddenly, may easily raise the temperature to the igniting point

of gunpowder. When loaded shells are recovered after firing, the powder is sometimes found pulverized and compressed into a solid cake, which adheres to the base of the shell.

It is believed that all attempts to fire high explosives from powder guns, are *improvements* in the wrong direction. Their effect is not great enough to balance the fact that a premature explosion means destruction of life as well as of the gun.

If it be true that we are not likely to have any of the enormous guns so often spoken of, it is also true that so far as land defenses are concerned we have no need of them. If there were no guns in the country larger than 10 inches calibre it would still be possible to defend our harbors against any ships now afloat or likely to be launched for many years to come. As a recent military writer has said, the navies of the world cannot be rebuilt in a day and in fact they can only be revolutionized by a slow and gradual process.

The fight between Ordnance and Armor was long since practically given up by floating armor, and ships no longer pretend to be invulnerable. Even the heavy armor of the Citadel or Turret has not been increased in recent years, while the great areas of both hull and deck are only what might be called "tin clad," since they may be easily perforated by the smaller calibres of guns, say 6- and 8-inch rifles. Neither is the question of range dependent on the construction of larger calibres of guns. The longest range on record is that of the celebrated "jubilee shot" which was fired from a 9.2-inch rifle, and is reported to have exceeded *twelve miles*. Such a range would be of little value against ships, as the chances of hitting a vessel at that distance would be almost *nil*, and would only be of use in bombarding cities, dockyards or other extensive areas.

In the use of long range guns forts would have a greatly increased advantage over ships, not only because of the steady platform but because they can use much higher elevation than is generally allowed on shipboard. The forts would also have a decided advantage in facilities for triangulation and otherwise locating the enemy, and in ricochet shots which would always be dangerous to a ship but practically harmless against a fort on a high or even a medium site.

On the other hand, even if safe guns of 12-inch calibre and upwards can be brought against earthworks, their destructive effect can never be proportionally as great as against the armor

of other ships, since the penetration in earth increases very much less rapidly than the velocity of impact, while in armor the penetration is nearly proportional to the striking velocity.

As guns increase in size they are bound to diminish not only in rapidity of fire but in numbers, unless we have an unlimited site either floating or permanent for mounting them and an inexhaustible treasury to pay for them. For example, instead of eighty and 120 gun ships we now have eight to twelve gun ships, and the chances of hitting an object are bound to diminish with the number of shots fired at it.

Not only has the number of guns carried by ships diminished in something like tenfold ratio, but the number of ships themselves has been greatly diminished, and this notwithstanding that the cost of ships both per unit and per fleet has enormously increased.

The musket has been diminished in calibre from 0.58-inch to about 0.30-inch without diminishing the range or accuracy and without weakening the destructive effect of the impact below what is needed to destroy the enemy.

In like manner it seems highly probable that the calibre of sea-coast guns will be reduced for the reasons already stated, and that a calibre of say 10-inches will not only be found as large as can be safely constructed, but large enough for all the purposes of defensive works. A ship riddled with shot 10-inches in diameter which will perforate both side and deck armor, allowing shells to explode between decks or in the hold, will not remain long in line of battle, and it is not to be wondered at that even the best naval authorities now admit that ships are unable to cope with well appointed land defenses, when the latter are well armed and manned.

No naval architect would now pretend to build a ship with armor that could keep out even the medium calibres of projectiles, except in some very limited space like a turret or bulwark. The greater part of the freeboard of most battle ships can be easily perforated by a 6-inch rifle or even smaller calibres, and the so-called protected decks can be perforated by mortar shells at almost any range.

It is not probable therefore that any ship could be held for any considerable length of time under the fire of a well appointed land battery, and certainly not if there were several batteries firing at her simultaneously. If an exceptionally reckless com-

mander should risk such an engagement as did Captain John Rodgers at Drury's Bluff, when he held the *Galena* under fire of the land batteries to test her powers of endurance, he would be likely to come out of the engagement as did Captain Rodgers with very little to show for his temerity, except a badly damaged ship and crew, while the shore batteries would hardly feel the effect of his attack.

The almost universal sentiment of naval as well as military authorities is that ships must not attack shore batteries unless they have an overwhelming advantage, either in guns, men or morale.

The conclusion is that we need not worry ourselves about the difficulties in the way of making heavy guns, for we have very little need of them in land defenses. We don't use a broadaxe to split a shingle nor a sledge hammer to drive a fence nail.

The all important thing to be done, however large the calibre of the gun may be, is to *hit* the enemy and if possible in some vulnerable spot, and to do this we must have a sufficient *number of guns* as well as *accuracy of fire*.

To reduce the number of guns, other conditions being the same, is to diminish the number of shots that will strike the enemy in a given time. Of course we may increase the rapidity of fire as in case of rapid fire guns, but this can be done much better with light than with very heavy guns. Again there is no doubt that by using a few heavy and very costly guns, we are putting our eggs in one, or at most in a very few baskets, so that if any accident happens to one of our guns or its complicated carriage, either from breakage or from the enemy's shot, the loss will be much more serious than if we had a large number of smaller but sufficiently powerful guns. With light guns any little difficulty in working the carriage can be overcome by a corresponding increase in man power, but with the ponderous and complex machinery of heavy guns no such application of power would avail anything.

Another conclusion follows from the foregoing discussion, viz.: That we should make full use of all the serviceable guns we have. Because there is something better is no excuse for ignoring that which is useful, even in a moderate way.

We have over 300 fifteen-inch Rodman guns and a large number of 8-inch converted rifles and guns of smaller power, and in my opinion even the smallest of these should be utilized in any

scheme of fortification. They have cost many millions of dollars and would be worth almost nothing for any purpose except that for which they were made.

These guns are far from being useless even in conflict with the most improved naval outfits.

*They will perforate all parts of some ships and some parts of all ships* up to effective bombarding ranges, and their fire would furnish effective protection to the so-called "high power" guns. As Colonel Alexander used to say "the best way to protect a gun is to mount another gun alongside of it." There is too much of a tendency in these days to lose sight of the "offensive defensive" and even to sacrifice offensive power to secure mere passive defense. The folly of this is apparent from a moment's consideration. To take an extreme case we might abandon all attempts at passive defenses such as parapets, turrets, etc., and still make the offensive power of our batteries sufficiently great to drive off a fleet just as one army drives another from the field, but on the other hand no possible expenditure for purely passive defenses would be of any avail.

In balancing the considerations of offensive and passive defense I would not dispense with a single gun now on our works unless absolutely controlling reasons demanded it.

Most of the advantages of the much talked of "quick fire" guns can be attained by a sufficient number of ordinary guns firing canister, especially for such work as flanking torpedoes, ditches, etc.

I must also admit my inability to see the enormous advantages claimed for "smokeless powder," especially for the defense. If we have a proper system of range finding and pointing guns by direction of observers at a distance, the greater the amount of smoke in front of the battery the better. In fact a thick curtain of smoke would be a great protection to the defense and I have long believed in the feasibility of distributing smoke from some central point by pipes buried in the earth in front of our casemates and barbette batteries. Such a system might be so arranged, by varying the jets of smoke, as to give the enemy the impression of a moving object or at least to conceal all outlines of guns or parapets.

The fact that guns are again increasing so enormously in length and the enormous cost of mounting and masking them by parapets, suggests the possibility of a return to "guns of posi-

tion" like those made centuries ago by the Turks for the forts on the Dardanelles. These guns were so long and heavy that they were given a fixed position and no attempt was made to traverse them or to change their elevation.

Let us suppose for example that a suitable site is selected where a battery of 10 or 15 guns could be mounted in galleries 20 or 30 feet below the surface and but a few feet above high water level.

These guns could be made of cast-iron, say 24-inch calibre and 100 feet long, and made to load at the breech, the recoil being resisted by a cast-iron breech block, backed by concrete which would rest against the solid earth. The loading could be done in a gallery behind the guns and at right angles to them.

The guns should be placed horizontally or nearly so and, say 100 feet apart in parallel lines, so that 10 guns would absolutely cover a zone 1000 feet wide across the channel.

The axis of the guns should be below the level of the deck of a ship, and as the shot would ricochet in very flat trajectories it would be impossible for it to miss a ship that happened to be in its line.

As a very slow powder could be used in such long guns and small charges would be sufficient to give high velocities, on the principle of the pneumatic gun, the mean pressure could be kept down to say two thousand pounds per square inch and yet give sufficient energy to the enormous projectiles to crush through all floating armor.

It would simply be necessary to know that an enemy was within the 1000 foot zone of fire to destroy him with absolute certainty by a single volley from the ten-gun battery.

The cost of this arrangement would be a mere fraction of that of any battery of modern high power guns of equal efficiency, and the gunners would be absolutely protected not only from the enemy's shot but from the accidental explosion of their own guns, since the guns could be so firmly imbedded in concrete and earth that an explosion of a gun would not blow out at the surface. Of course heavy shells could be fired, but it is thought that the simplest way would be to depend entirely upon the crushing effect of the enormous solid shot, which should be accurately centred so as to prevent "balloting" in the gun.

No range-finding devices and no mechanism for traversing or elevating the guns would be needed. Neither would any steam

or hydraulic power be required. The gun could be cast in sections of convenient length and screwed together; eight inches would be a sufficient thickness at the breech and four inches at the muzzle.

The shot would weigh about 1800 pounds and, with a mean pressure of say 2000 pounds per square inch, it would have an I.V. of 1760 F. S. and a kinetic energy of 43,000 foot-tons, which would undoubtedly perforate the heaviest armor afloat.

Such guns could easily be made much larger, say 36 inches in calibre, but it is not believed that such an increase would be necessary; and it would be better to increase the number of guns than to increase their calibre.

## QUERIES ON THE CAVALRY EQUIPMENT.

BY LIEUT. JAMES A. COLE, SIXTH U. S. CAVALRY.

SOME years ago, when a certain ambitious young officer of our army sent General Sherman a model of a tent which was a great improvement over all other tents in existence, he was informed that the general had marched through Georgia and the Carolinas using the Sibley for tentage, and thought that the army could still rub along using a tent that did not perhaps possess all the advantages of the model. This may be the status also of our cavalry equipment, which has enabled our troopers to give such a good account of themselves wherever their services have been needed. But much of our equipment is the result of deep thought on the part of officers of the Ordnance and Quartermaster's departments and has been continued in use as steadfastly as if no recommendations on the part of officers of the mounted service had ever been made in regard to it.

It is safe then to assume that there are faults in the equipment and that they will remain for some time to come and that therefore a discussion of them will be useless; nevertheless let us point out the faults and the manner in which they may be remedied.

Following the fashion set by the new drill regulations I will attempt a definition of the cavalry equipment from the standpoint from which I wish to consider it.

The cavalry equipment is made up of what a cavalryman has to take into the field to enable him to live in campaign, march and fight,—all to the best advantage. It should be simple, strong, light in weight and as inexpensive as is consistent with thorough utility. The cavalry horse might properly be discussed as part of the cavalry equipment, but as the horse is to be made the subject of a special paper I may simply say that so long as the cavalry ride a choice selection of carriage horses, street-car horses, plough horses, canal horses, dray horses, saddle horses and poor horses, all without military antecedents, the service will not be what it should be.

In this connection attention is invited to Remington's illustrations in a recent number of *Harper's Magazine* showing what a

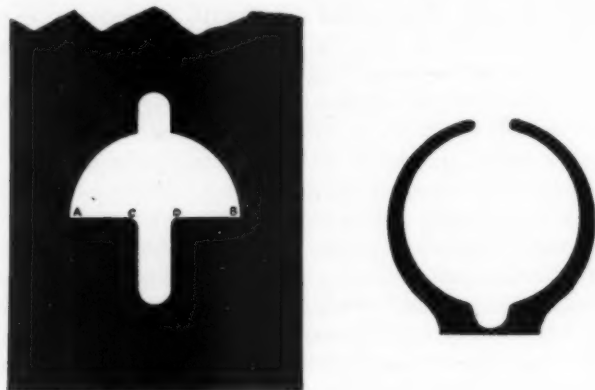
German trooper is expected to do with his mount. Our men, if properly mounted, could at least equal the feats of the Germans, being far and away better riders naturally.

In discussing the equipment proper, no apology is made for the ideas advanced. The subject is one of frequent discussion among officers, and one is naturally influenced somewhat by the opinions of his associates in the service. The subject is one on which every cavalryman has ideas of his own.

*The Carbine.* The cowboy gives his Winchester carbine (cal. .44) as hard usage as a gun can very well get. He throws his saddle on the ground leaving it in the holster; his broncho falls on it once a week; it is always rusty, dusty and old, but it generally goes off when expected to. It is a light, handy weapon that can be fired at arm's length if desired.

Now we do not want the Winchester in the cavalry, but at the same time we are taught by seeing this little weapon in use that an arm with a far more complicated mechanism than our present one may receive severe usage for a long period of time and still be relied on. Moreover, this weapon is made very light in the stock, trigger-guard, hammer, etc., while our poor old carbine is buttressed into unwieldiness to enable the cavalryman to come to an order just like the infantry. When the small calibre arm is issued to us let us hope that it will be a weapon with a barrel an inch or two longer than that of the present carbine, with the fore-arm running to within four inches of the muzzle, the wood of the stock and fore-arm being sufficiently strong to admit of the use of a moderate quantity only, and this idea carried to all parts of the construction. Add to this the detachable magazine principle, making the magazine of cheap enough construction to admit of throwing it away without great loss when an emergency requires it; or better, making the magazine the original cartridge package; place the sights as far apart as the breech mechanism will permit, and the cavalry will be better off than at present.

*The Sight.* Hunters who shoot at running game are apt to use the buck-horn sight. Such an one, slightly notched, is proposed for the carbine when the leaf is not to be raised, the normal sight being the half sight in the notch. When the leaf is to be raised the sight shown in the cut is proposed. This will enable the marksman using a half sight to change his aim an eighth of an inch vertically without sliding the leaf. The diameter of the aperture AB is equal to the length of the base of the triangular



aperture in the present leaf sight. The width CD of the aiming notch is the same as that of the present notch, its depth being however, the radius of the circle instead of half the width of the notch as at present. The upper edge of the notch is rounded, as it has been my experience at least, that the sharp edge tends to poor definition in aiming. The front sight being made slightly thinner than the present one, a square of white bone or lacquer so placed as to show the firer its full size at the top of the sight, is proposed as having proved valuable in shooting at indistinct objects.

*The Sight-guard* should protect the wind-gauge screw. Friction against the boot frequently throws the present gauge off as much as a point and a half, in spite of the guard.

*The Sling-strap* should be of strong webbing, an inch wide, with a small snap which should never be detached from the carbine while mounted. This would insure taking the carbine off the saddle on dismounting.

*The Pistol* is of doubtful utility; not because it cannot be made effective in the hands of a well-instructed man who keeps his head, but because the soldier ought to spend so much time learning to use his carbine mounted, as to leave no opportunity for learning to shoot his pistol. But if we are to retain the pistol, let us have one that at fifty yards range will deliver a blow like that of a crow-bar powerfully thrust,—that is, a five-shot weapon of cal. .50, six-inch barrel, carrying as heavy a ball as can be fired without the pistol's kicking up, with just enough powder to produce the

above effect. The nervous shock, for the moment at least, will be greater than if the penetration had been greater.

*The Pistol-holster* should be fastened to the saddle just behind the right thigh, with an attachment that can serve as a belt attachment as well. The pistol is a very good weapon to dispense with except when there is every probability of its being needed. A service pistol ought to be capable of being loaded by cartridge pack, and two packs should be carried,—fifteen rounds in all. The new Colt's navy revolver has a very satisfactory action.

*The Sabre* could be made three inches shorter to advantage, the general curve lessened and made uniform, and the weapon made stiffer by making the shank T shaped, the T forming the back of the gripe. The hilt should be of steel for officers and men.

*The Bridle.* The following modifications in the present bridle are proposed, in order to combine halter and bridle for field service. The head-stall, particularly the cheek pieces, being made heavier than at present, loop into the cheek pieces an inch and a quarter iron ring to snap the bit into, leaving another loop immediately above the ring loop to pass the halter strap through. Pass the small end of the halter strap through one of these loops from rear to front, then over the nose and from front to rear through the other strap loop, and finally through an inch and a half ring in the other end of the halter strap so as to make a slip knot with a very easy play, under the jaw. That part of the strap passing over the nose should be round. It is believed that this will make a serviceable halter bridle. In garrison the ordinary halter may be used when a halter is needed, the halter bridle however being used for all mounted duty. As a modification of the above, a strong nose band, or nose piece, with a ring under the jaw to which a halter shank can be snapped, is suggested.

*The Reins* should be fastened to the bit by a brass safety chain ten inches long,—this to avoid cracking and rotting of the leather from watering with the bit in the mouth, it being frequently impracticable to dismount and unbridle before watering.

*The Bit* is a portion of the equipment on which enough money should be expended to secure a good article. It should be forged of first-rate steel, very light, with a straight curb bar, terminating in a rigid ring of which the bar prolonged is a diameter. The snap ring terminating the rein chain would thus have free play in both directions for riding or leading. The bit should be heavily nickel-

plated, with "U. S." stamped in the metal instead of upon two cumbersome brass plates attached for that purpose.

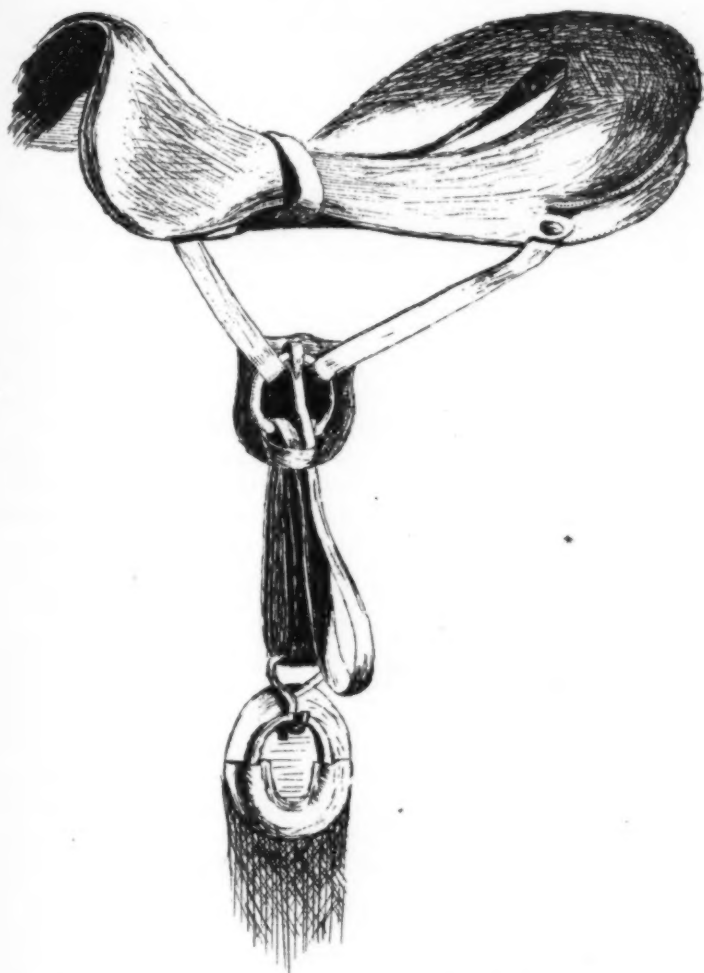
*The Saddle* is a good one. It is believed though, that the seat could be brought nearer the horse's back, the stirrup irons set further forward, the pommel and cantle lowered, and several pounds taken from the weight of the tree, all to advantage. Where coat-straps are now used, long leather thongs could be substituted with added convenience. The staples holding on the saddle rings should be driven through and clinched, to prevent their coming out as they frequently do now.

The double cinch would insure the saddle's staying where originally placed. Captain Scott tells me that during last winter's campaign he rode with a double cinch loosely adjusted. His saddle, once in place, needed no further attention. The single cinches needed frequent looking after. For rapid cinching an attachment similar to the one here shown is suggested. This attachment admits of swinging the cinch clear of the horse's body without untying the cinch knot. This is an advantage in simplifying saddling and the adjustment of the blanket.

Packers put canvas next to a pack-mule's back. Why not make the shelter-tent of canvas, fold it in four thicknesses and put it under the saddle blanket? The blanket and shelter-tent combined would make a very good emergency horse cover. The shelter-tents should be tied together instead of buttoned. Horse-covers, when carried, should be of waterproof canvas, woollen lined and double breasted.

*Saddle-bags.* It would hardly be an exaggeration to say that the saddle-bag in use is heavier than the heaviest load it is required to carry. This is literally true if cartridges are not considered. It is certainly a monstrosity. Would it not be better to substitute a brown canvas bag of similar shape, the strip connecting the bags being reinforced with leather? Such bags, with good sized flaps, each tied with a single pair of thongs instead of buckled three times, would at least be better than the present issue.

The present *Curry-comb* is too harsh, heavy and bulky. It cannot be used all over the horse and causes dandruff. Suppose we have a sole-leather back, shaped like a half ellipse, or the extended hand from the middle palm to the end of the fingers, with a holding strap over the broad end, the brush being of such size as to permit the fingers of an ordinary hand to overlap the



rounded end of the back. For teeth let us have stiff bristle, one-half inch in length, arranged in groups about as far apart as in the ordinary scrubbing brush, the bristles in the groups being far enough apart to admit of individual penetration. Such a curry-comb ought to be a good one.

*Sharp shoeing* all around is not desirable on account of the severe wounds a horse so shod can give in kicking. It is believed,

though, that low toe and heel calks for the front shoes would be of material advantage in northern countries. The front shoe could be made much lighter than the present issue to advantage. One hind and one front shoe ought to be enough to carry as extra, with the horse equipment.

So much for the horse equipment.

The cavalry soldier wants a good dirt-colored canvas uniform for the field,—almost the color of the present issue fatigue suit after fading thoroughly. The canvas should be slightly heavier than in the present issue, thoroughly waterproof and neatly made to fit. The blouse collar should be about three inches broad, to turn up to protect the neck. There should be a flap pocket on the right side, well up, for the pistol cartridge packs, and, if the cartridge belt is not modified, an emergency flap pocket on the same side, above the cartridge belt, with ten shallow cartridge loops for that number of cartridges,—these to be used when rapid fire with a single loader is required. If the detachable magazine principle is adopted, and the field belt made to carry three or four of these magazines, such a pocket would not be needed; at present, however, with the carbine cartridge pressed down into the cartridge loop until the top of the bullet is even with the lower edge of the loop, it is a matter of some little difficulty to get out a cartridge, especially when in a hurry. The loop being made shorter would add to the chance, already a good one, of losing ammunition.

Two weights of field uniform should be issued, the winter weight being heavily woollen lined, with the collar of the blouse and edge of the cuff faced with the lining to prevent chafing. The trousers might very properly be left open along the leg from about six inches below the knee down, so as to fold tight around the leg under the legging.

The present *Campaign hat* looks very neat when it is new, and extremely disreputable when it has been worn awhile. Moreover it can be worn so as to look like three or four different kinds of hat. A strong flexible canvas helmet is suggested as a substitute. There should be absolutely no stiffening in this helmet except in the brim, which should be of two thicknesses of canvas tightly stitched together. The crown should be made in four or six pieces. Such a headgear can be made of good heavy windproof canvas, be worn an indefinite length of time in all weathers except the coldest, and will always look trim and military if not

especially handsome. I have seen these helmets in use,—in fact have worn them, and I found mine far more comfortable than a campaign hat. They ought to cost about half as much. The canvas cap, flannel lined, now issued for winter use, is in every respect serviceable.

The blue shirt makes a beautiful bull's-eye and should be changed to a neutral color like the proposed field uniform.

*The Cavalry boot* is a survival that can be allowed to sink into innocuous desuetude with great advantage to the cavalry service. It is bulky, heavy,—a stick, leaf and snow catcher,—and, when wet, as frequently happens, next to impossible to get into or out of, making it sometimes necessary to go to bed with the boots on. What is wanted is a legging of the same color as the field uniform, made of leather or of canvas reinforced with leather in parts subject to special wear, and held in position by a long steel spring that requires simply bending to remove the legging. The legging should reach the base of the knee-cap in front, and be just long enough behind to prevent chafing under the knee joint. A cavalry soldier spends a great deal of his time afoot, on the march and in camp, and generally does most of his fighting in Indian campaigns on his own legs. He may also be in a hurry to mount his horse and the horse may be plunging and making every effort to escape. Imagine a soldier vaulting into the saddle under such circumstances, with a boot of the present issue attached to each foot!

*The Spur* should be larger than it is, so as to fit the heel easily, an adjustable chain permanently fastened on one side passing under the foot and hooking on to one of the spur studs, and the spur strap broad over the instep, with buttonholes on each side also fastening to these studs, which should be made with rather broad heads. The bearing surface of the spur should be twice what it is at present, and should rest with its lower edge two inches and a half from the tread of the shoe. The spur shank should have a downward curve, so that the lowest point of the rowel will clear the ground by an inch. The rowel should set close to the heel, be an inch in diameter, with the circumference notched to a depth of one sixteenth of an inch. The spur should be strong and light. Steel, nickel plated, would be serviceable and handsome.

Officers spurs should be made by the Ordnance Department,—this to prevent the licensed robbery now permitted.

Cavalrymen serving in extremely cold climates should have

sleeping bags, particularly when ordered for service away from wagon transportation. A sleeping bag of water and windproof canvas, made tight to the waist and to lace the rest of the way, can be rolled so as to tie behind a saddle with a blanket or slicker and not make a large roll. It will of course be long, and will not fill the military eye of the stay at home soldier, but the sleeping bag so carried, or otherwise carried, would be a very welcome addition to the equipment.

Now, when a satisfactory equipment has been obtained, would it not be a good plan to see that it is used? At present when troops go into the field, each soldier is allowed to give a more or less free rein to an always fantastic taste. The result is a remarkable combination of the product of the Quartermaster's Department, canteen and post-trader's store, in the way of clothes, pistol belts, gloves, etc. This is allowed because a man must be comfortable in the field, particularly in cold weather, and he cannot be so if he relies on the authorized departments for his outfit. But as soon as these departments issue the parts of a field equipment which officers find to be as comfortable as similar articles to be purchased outside the departments in question, soldiers should be required to stick to regulation patterns.

One or two troops of cavalry, and even a large command, are sometimes suddenly ordered for duty away from all transportation, which will necessitate taking rations for from one to five days in saddle pockets. A mixed ration, composed of flour, meat and vegetable already cooked and made up into ration sausages, ought to be available for such emergencies. The French and German armies have such a ration. The Mexican soldier, taught by experience, carries his pinola and pinoche and has done so for years, in scientific simplicity long antedating his continental rival. Beef extract, carried in very small compass and needing the addition of hot water only, would for a few days do very well as a substitute for coffee.

In the course of this paper many liberties have been taken with the cavalry equipment. I have felt reasonably safe in doing so, since most cavalry officers agree in saying that much of the equipment needs improving. I have ventured to indicate where and how, in my opinion, improvement is practicable.

## THE ARTILLERY SERVICE IN THE WAR OF THE REBELLION, 1861-65.

BY BVT. BRIG.-GEN. J. C. TIDBALL, U. S. ARMY.

*(Continued from JOURNAL, No. 59.)*

### VII. CHICKAMAUGA (*First day*).

AS stated in a former article, the Confederate army under Bragg withdrew, after the battle of Stone's River, leaving the Federal army under Rosecrans in possession of the field. Bragg withdrew behind Duck River, some 37 miles distant, and intrenched his army among the rugged hills and defiles around Tullahoma.

Rosecrans continued at Murfreesboro until the 22d of the following June, (1863) when he commenced a series of movements which caused Bragg to leave his strong position and fall back 82 miles across the mountains to Chattanooga. In these operations there was considerable sharp skirmishing and some combats, but nothing approaching a general engagement. Arrived at Chattanooga, Bragg strongly intrenched his position, and awaited the development of Rosecrans' plans. The latter immediately commenced preparations for an advance upon Chattanooga, now become his objective; to reach which he had to cross, not only the Tennessee River—in itself a great obstacle, in the presence of an enemy—but several exceedingly rugged ridges of the Cumberland Mountains.

On the 16th of August he commenced his movements, and by a system of strategy and logistics rarely equalled in campaigning, so threatened Bragg's lines of communication as to cause the latter to withdraw from his chosen stronghold, which some of Rosecrans' troops entered as he was leaving. This was effected by the 9th of September, and by Rosecrans crossing his army at several points below the town, but at distances so widely separated as to make his flanks no less than 45 miles apart.

Bragg, upon withdrawing from the town, retired to La Fayette, about 25 miles nearly due south from Chattanooga and nearly opposite the centre of Rosecrans' extended line. Between the two

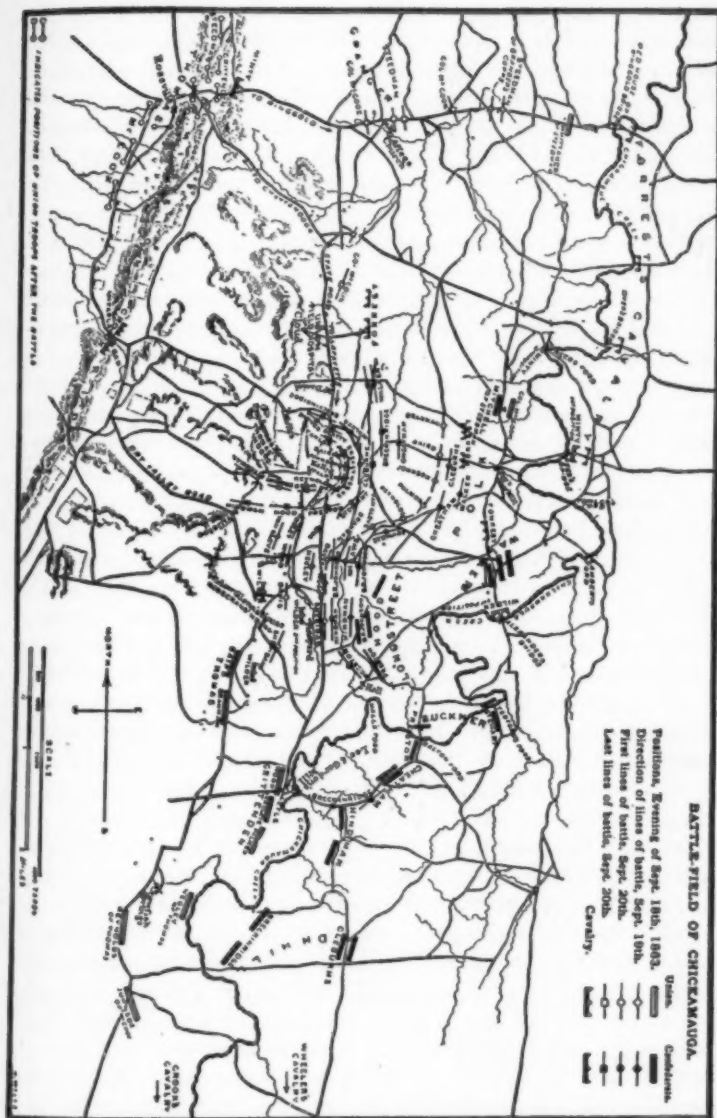
opposing armies stretched four ridges of mountains, first : Raccoon Mountain, next the river; then Lookout Mountain, and the Missionary Ridge, and then Pigeon Mountain. In order to concentrate his army, it was necessary for Rosecrans to cross these ridges at several passes, and while doing so Bragg endeavored to meet the separate columns as they emerged therefrom, and defeat them in detail. But this plan failing through want of promptness in some of his subordinates, he hastened to attack his enemy while in the act of concentrating.

It therefore became of vital importance to the Federal commander to get his disunited corps together as quickly as possible. But Rosecrans, mistaking the character of Bragg's movement, and thinking him in full retreat towards the interior of Georgia, instead of concentrating at once, hastened forward Crittenden's Corps from his extreme left, and McCook's from his extreme right, in pursuit; thus still further separating his scattered forces, and this by an intervening country exceedingly rough, and with but few roads, and those of the poorest kind.

When it was ascertained that Bragg was not, as supposed, on the retreat, but was holding his army at La Fayette, preparing to strike the scattered forces of his opponent, intense anxiety was felt by Rosecrans and his subordinate commanders; but by strenuous exertions a concentration was effected before Bragg gave his contemplated blow.

This concentration was effected in the valley of the Chickamauga, lying between Missionary Ridge and Pigeon Mountain. The corps of McCook and Thomas were closed in to their left upon that of Crittenden which had been recalled from Ringgold, where it had been sent as before stated in pursuit of Bragg. The latter had made efforts to prevent the concentration, but the tardiness and want of energy of some of his subordinate commanders thwarted his purposes. Heavy reinforcements having arrived from Lee's army in Virginia and Johnston's army of the Mississippi, he now determined to attack and crush the Federal army as a whole. His attack was to have been made on the 18th, but owing to the bad roads, small bridges, difficult fords and dense forests, his operations were delayed until early morning of the following day.

The Chickamauga is a large creek flowing northeastwardly between Missionary Ridge on the west and Pigeon Mountain on the east, emptying into the Tennessee River three miles above



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the town of Chattanooga. From crest to crest of the two ridges just mentioned the average distance is only about seven miles. The included valley is undulating, rough, full of ravines and with edges much broken by projecting spurs of the ridges. Being but sparsely settled it was chiefly covered with forest, thick with underbrush. The State road leaving Chattanooga and running almost due south through La Fayette, crosses Missionary Ridge at Rossville Gap, three miles from Chattanooga; then, skirting along the easterly flank of the ridge, crosses Chickamauga Creek at Lee and Gordon's mill, distant from Chickamauga fifteen miles. It was along this road between Rossville Gap and Lee and Gordon's mill that the Federal army found itself concentrated on the morning of the 19th, when Bragg made his attack.

These are the general features of the country about Chickamauga; but as the special topography of the field had an unusual influence on the events of the battle, especially as to the employment of artillery, it is necessary to particularize certain features of it to obtain a full understanding of the conflict. The ground upon which this took place lies between Missionary Ridge on the westward and Chickamauga Creek on the eastward, both of which have a north-easterly and south-westerly direction, and are distant from each other, that is from the crest of the ridge to the creek, about four miles. The State road bisecting the ground upon which the battle was fought, may be taken as the axis of the field; and along it are several points which, although they had no influence, *per se*, upon the military operations, are nevertheless important as points of reference. The first of these is the McDaniel house and fields, about three miles from Rossville. Near this house was the Federal left. About a mile further south is the Kelly house and fields; this was the centre of Thomas' position, and was the scene of the most constant, persistent and sanguinary struggle of the battle. About half a mile further on is the Brotherton place, the point struck by Longstreet's column of attack which swept away the entire right wing of the Federal army. About a mile further on is another house and fields, known as the Vineyard, near which rested the Federal right on the morning of the first day. This does not, of course, include the fields of operations of the cavalry, which generally were on the flanks of the main force.

West of the State road and almost parallel to it runs the Crawfish Spring road from which diverges the Dry Valley road

at the Glenn house about a half mile in rear of the Vineyard. The Dry Valley road winds up a cañon and crosses Missionary Ridge at McFarland's Gap, and thence on by way of Rossville to Chattanooga. From McFarland's Gap to Rossville Gap, along the crest of the ridge, is about three miles. Spurs of the ridge extend down almost to the State road, the most important one, and one which figured largely in the battle, being the Snodgrass Hill, more especial mention of which will be made further on.

From the State road eastward to the Chickamauga, an average distance of about two miles, the land is rolling and covered with primeval forest and thick undergrowth; but here and there are small clearings and fields, not sufficient, however, to have had much influence in a military point of view.

In this forest took place the battle of the 19th, as also part of the battle of the 20th. A large part of the fighting of the second day took place along the line of the road and upon the slope of Missionary Ridge, where the field was also greatly obstructed by woods and underbrush. Farther up the slope of the ridge the ground, being more cultivated, was less obstructed.

From several bridges and fords across the Chickamauga, country roads ran through the forest to the State road, affording the Confederates means of approach from the further side of the creek, while the space between the latter and the State road afforded him ample room for deploying his columns, screened from view by the density of the forest.

Rosecrans' army consisted of the same three corps with which he had fought the battle of Stone's River. These were as follows:

The Fourteenth; commanded by Thomas, and consisting of the divisions of Baird, Negley, Brannan, and J. J. Reynolds. The Twentieth; commanded by Alex. McD. McCook, and consisting of the divisions of Davis, R. W. Johnson, and Sheridan. The Twenty-first; commanded by Crittenden, and consisting of the divisions of T. J. Wood, Palmer, and Van Cleve.

Each of these ten divisions had three brigades, to each of which was attached a battery.

The Cavalry Corps, commanded by R. B. Mitchell, consisted of five small brigades and one battery.

Wilder's Brigade of infantry of Reynolds' Division was mounted and served as cavalry.

In addition to the foregoing was a provisional or reserve corps

commanded by Gordon Granger; only three brigades of this, however, were present, and these were posted at or near Rossville Gap to hold that important position against the enemy.

The other three corps extended along or near the State road, from about six miles south of Rossville Gap, to Lee and Gordon's mill about five miles farther on. On the evening of the 18th they stood:—McCook's on the extreme right; Crittenden on the extreme left and Thomas in the centre. Wagner's Brigade of Wood's Division of Crittenden's Corps had been left behind as a guard at Chattanooga, and was the only organization in the entire army not upon the field. The divisions of Brannan and Reynolds, with their six batteries, absent from the battle of Stone's River, had now rejoined Thomas' Corps. In all there was an addition to Rosecrans' force since Stone's River, of 37 regiments of infantry and nine batteries of 48 guns. The cavalry had received but little augmentation.

Bragg's army as it stood confronting Rosecrans' consisted of the corps of Polk, Walker, Buckner, and D. H. Hill, together with a provisional corps under Hood. The right wing was under Polk; the left under Longstreet, who had just arrived with two divisions of his corps from in front of the Army of the Potomac in Virginia. Buckner, who had been guarding eastern Tennessee with his corps, was brought from Knoxville, while several brigades had arrived from Johnston's army recently operating in rear of Grant while the latter was besieging Vicksburg.

Bragg's army, actually in the field and engaged in the fight, consisted of 184 regiments of infantry, 28 of cavalry and 43 batteries, of about 190 pieces. Against this force Rosecrans opposed 142 regiments of infantry, 18 of cavalry and 34 batteries of about 195 guns.

Longstreet did not have his batteries from Virginia with him, which accounts for Bragg's greater percentage of infantry.

According to the best data available, Rosecrans' army numbered about 65,000 of all arms, while that of his adversary was about 85,000; which is about the proportion given by the number of regiments in the two armies.

Of Bragg's 35 brigade commanders of infantry, all but four had their appropriate rank, that is, they were brigadier-generals; while with Rosecrans, nineteen out of his thirty-two brigade commanders were colonels. An examination of the rosters of other armies shows about the same status; and this notwithstanding

the fact that the proportion of general officers in the Federal service was greater than in the Confederate. To the thoughtful this has a deep military significance.

This absenteeism was not, however, so much through the fault or delinquency of the officers themselves as from causes generally beyond their control. Many were "shelved," chiefly in the first part of the war, because they had not fulfilled the highly wrought popular expectations of the times. Many were mere political appointments, or appointments representing certain foreign elements who, when tested by actual command in the field were found wanting and had to be "shelved" or put upon other duty. Others were in attendance as witnesses before the "Committee on the conduct of the War," where some of them were either grinding their own axes or dulling those of others. These were some of the causes producing the evil of absenteeism referred to. The straitened circumstances of the Southern Confederacy admitted of no such loose practices.

As against the foregoing class of "dead heads" in the Federal service, was another class composed of those who were habitually with their commands in the field, and whether good or bad as generals, were attending to their duties faithfully.

While quite a number of promotions in other branches of the service justly followed the Stone's River campaign, none, not even one, was vouchsafed to the artillery, and this, notwithstanding the distinguished services of some of the officers of that branch. Battery commanders still remained battery commanders. The organization of this branch of service, especially in the Army of the Cumberland up to this time, had no use for any higher grades than that of battery commander, hence such officers were doomed to serve without the soldierly hope of advancement.

Profiting by the lessons of Stone's River, Bragg reorganized his artillery by uniting the batteries of each division into a battalion, to which was assigned an actual commander—a field officer of appropriate rank; and, in addition, each corps had its battalion of corps batteries, besides all of which there was an army reserve of several battalions.

Rosecrans, on the other hand, left his batteries still attached to his diminutive infantry brigades, trusting apparently that should another disaster happen, his artillery would notwithstanding rise to the occasion and again enable him to hold the field. But what was done at Stone's River was fated not to be repeated at Chickamauga.

Following the ordinary regimental organization of artillery, the 36 batteries that Rosecrans had should have had 15 field officers. There were in reality but two, and these had no actual command over the batteries, only a mild species of administrative function as staff officers. Eighteen of Rosecrans' batteries were "Independents" without regimental organization, and therefore not entitled to field officers.

Bragg issued his orders for an attack to commence at daylight on the morning of the 19th. His plan was to cross his troops over the Chickamauga during the night. Hood's Corps upon the right was to strike the extreme left of the Federal line, supposed to be Crittenden's Corps, and, doubling it up, was to sweep down the line, while the other corps in succession were to take up the assault from right to left, and complete the victory.

Polk, commanding the right wing, was dilatory, and not in readiness to commence the attack until long after the appointed time. In the meanwhile some changes had taken place in the Federal line which modified considerably the expectations of Bragg.

Through the activity of his cavalry, Rosecrans became aware that the enemy were moving northward down the Chickamauga, thus threatening to cut off his communication with Chattanooga by the Rossville Gap. To extend his line in that direction, he directed Thomas to move his corps in rear of that of Crittenden and come into line on the left of the latter. McCook was to move his corps to the left, filling the space vacated by Thomas and connecting with Crittenden's right. Thomas pushed forward uninterruptedly during the night, and at daylight on the morning of the 19th the head of his column had reached Kelly's house, on the State road, where Baird's Division was posted; Brannan's Division followed and was posted on Baird's left. Thomas' other two divisions, those of Reynolds and Negley, were delayed and before they could get up the battle was opened, and they never did get into their proper position.

This "on the right into line" movement was a manœuvre of inversion more appropriate for the drill ground than to the field of battle. In this instance it destroyed the solidarity of every corps, not one of which was left intact in its organization; and this led to the dismemberment of divisions also, until, as the battle progressed, scarcely one of these was left intact. A plain and simple movement, simultaneously, of the entire line along the

State road, upon or near which it was then posted, would have effected the object arrived at without the disorganization resulting from the method adopted. And the movement should not have been arrested at Kelly's house, but should have been continued on to connect with Granger at Rossville Gap, thus resting the left flank on Missionary Bridge, and securing it from being turned. As it was, both flanks of Rosecrans' army were in the air and both were turned, but not successfully.

It will be seen, as this account progresses, that this great battle, of two days, was one essentially of brigades. This arose primarily from the wooded character of the country, and secondarily from the tactical inversions just mentioned, the nature of the enemy's attacks, and to various other causes. The brigades as they moved from place to place were followed each by its battery, as best it could in such a wooded and broken country. Under such circumstances the batteries were not only an encumbrance to their brigades, but had their opportunities for usefulness reduced to a minimum while their exposure to capture and loss was a maximum. Some of them, becoming entangled in the forest in their desperate attempts to preserve connection with their brigades, were captured without firing a shot; while but few got opportunity of doing such work as they were capable of had they been properly organized.

An analysis of the official reports shows that the chief loss in guns and other artillery material occurred, not when the batteries were in firing positions, but when entangled in positions to which they had been led by their brigades. General Willich, an educated and veteran soldier whose brigade was conspicuously efficient throughout the battle, says in his report: "The ground being wooded and hilly, it would not allow free manœuvre for artillery, and I gave Captain Goodspeed instructions to keep his battery out of musket range, and in rear of the infantry until further orders, \* \* \* during most of the time, and during the most trying circumstances, I could give him very little advice, partly on account of the formation of the ground, partly on account of the character of the battle, the enemy charging on us alternately from all directions of the compass."

This is a fair picture of the operations of most of the batteries, and in a measure explains why so little real service was permitted to fall to the artillery. The reports of other brigade commanders are in monotonous harmony with that of Willich,

and taken in the aggregate, show that solicitude for their batteries occupied much of their time and attention; often too, when the exigencies of battle demanded the whole of both for their brigades. That the artillery was capable of doing much valuable service, will appear in that part of the narrative where, at a most critical period, a number of batteries became shaken loose from their brigades, and, uniting, checked the enemy when he had broken the line of battle.

Owing to the topography of the field, as just described, it was difficult, often impossible, for commanders to exercise personal supervision and control over their commands. Regiments, even, frequently became broken and their parts separated; but as a rule brigades managed to preserve a fair degree of integrity. Above this there was but little unity. The battle was therefore almost entirely a conflict of brigades, and can be understood only by following the operations of each, which makes an account of it unusually long, and full of details; and as the batteries almost invariably followed or attempted to follow their brigades, the operations of the artillery are inseparable from those of the brigades.

Soon after Thomas got the divisions of Brannan and Baird into position near the Kelly house, he received information that a brigade of the enemy was in his front near the Chickamauga, and that it had become isolated by having the bridge behind it destroyed. He was led to believe that it could be captured entire without great difficulty. He accordingly directed Brannan to send forward a brigade, supported by his other two, to perform this service. Croxton's Brigade, the first sent forward, advanced through the woods about a mile, when it came in contact with the enemy, not however as an isolated brigade, but in force. He soon became hotly engaged, and the brigades of Van Derveer and Connell were sent to his assistance. It soon became apparent that these brigades were getting the worst of the fight, and that the enemy was in heavy force. Thomas directed Baird to support Brannan with his division, consisting of the brigades of Scribner, Starkweather and King; the latter was the regular brigade, and had with it a regular battery—"H" 5th U. S. Artillery.

Each of the brigades, as they went in, attacked or were attacked with fury, and, although fighting most resolutely were driven back about half a mile, taking position finally upon a

slight ridge about three-fourths of a mile east of the State road. This was resolutely held until the close of the day, when the troops were withdrawn a few hundred yards to another ridge, which became part of the line of battle of the next day.

Croxton's Brigade, the first sent forward, was accompanied by an Ohio battery commanded by Lieutenant Gary, which however was unable to come into position for firing until after the brigade commenced to retire. Gary says he then received orders from his brigade commander to fall back and take position on a ridge to the right and rear. "From this position I threw a few shells at a high elevation, and over the heads of the infantry, for effect only. Three successive times during the day I was ordered by Colonel Croxton to a position in the face of the enemy, and each time the infantry was driven back so rapidly that I was again ordered to the rear as soon as I had obtained a position bearing on the enemy." His losses during this day were slight; but on the succeeding day he lost a number of men killed and wounded, together with many horses, one gun and some other parts of his battery.

Van Derveer's Brigade of the same division moved forward into the woods about a mile and a half and considerably to the left of Croxton's Brigade. Here it encountered the enemy endeavoring to push his way around to get in position to strike him in flank. The fight soon became hot and stubborn, but the brigade was forced to give ground. It was accompanied by Lieutenant Frank Smith's battery of the 4th U. S. Artillery, of four Napoleon guns. The two sections (platoons) of this battery, commanded by Lieutenants Rodney and Stephenson, were so judiciously handled as to do some excellent work, particularly with canister at close quarters. As the brigade fell back from one position to another the battery took up successive positions, changing front to fire to the right, left or front to meet each fresh attack of the enemy. Smith met with considerable loss in men and horses, but lost no guns. On the following day this battery, as will be more particularly mentioned, took position on Snodgrass Hill, and was the heroic battery of the battle.

Connell's Brigade was accompanied to the front by Church's Michigan battery. This brigade became united in the fight with Van Derveer's, and the battery, coöperating with Smith's, had the same experience as the latter, and did equally as good service, but in retiring had the misfortune to lose one of its guns. On the

following day Church's battery, although moving about attempting to follow its brigade, was enabled to do some good work; but finally, being caught in the disaster which befell the left wing of the army, was swept away, saving but one of its six guns.

After checking the advance of the enemy on the extreme left, Brannan's Division was moved back and around towards the centre to assist in repulsing attacks in that quarter.

When it became evident to Thomas that Brannan's Division was not equal to the task before it, the division of Baird was sent in to his assistance on his right. Baird's Division, as above stated, consisted of the brigades of Scribner, Starkweather and King; each with a battery. King, being upon the left, next to Brannan, was the first to advance. His battery, "H" of the 5th U. S. Artillery, the same that under Guenther had done such good service at Stone's River, was now under Lieutenant Burnham. King advanced through the woods until near Brannan's position, and while hotly engaged was forced to change front to meet an attack from heavy masses approaching on his right. Only one regiment and the battery had time to get into the new position before the blow was struck, and this scattered the entire brigade to the rear. The same blow struck and sent to the rear Scribner's Brigade which had come up on the right of King.

Lieutenant Fessenden, who upon the fall of the other two officers succeeded to the command of the battery, says: "During the morning the battery was ordered forward by Brigadier-General King, and came upon the enemy about 12 M. in a dense wood. The battery was hardly in position before the troops on the right giving way, it was exposed to a most terrific fire of musketry from the front and flank. General King ordered the battery to limber to the rear, but it was impossible to execute the order, since many of the cannoneers were killed and wounded and the horses shot at the limbers. At the first fire Lieutenant Burnham fell mortally wounded; Lieutenant Ludlow was also wounded, and myself slightly struck on the right side. The battery was taken by the enemy." The enemy soon after being forced to retire temporarily, the battery was recovered; but so crippled in men and horses as to be of no further service during the battle.

The caissons with all the ammunition had to be abandoned for want of horses to haul them off. At the same time the gun lost by Church was retaken.

The enemy in his reports made great triumph over the rout

of King's brigade of regulars, and the capture of the battery. All who were on that part of the field claimed the honor of it, but the distinction seems to be justly due to Liddell's Division of Walker's Corps.

Scribner's Brigade, the next on the right of King's, was attacked with equal vehemence, and with like result. It, too, was forced to change front, and with it the First Michigan Battery, under Lieut. Van Pelt, who was killed at his guns. When the brigade gave way, five of the guns of this battery fell into the hands of the enemy; one got off safely and one was subsequently recaptured.

The other brigade of Baird's Division—Starkweather's—was marched around in rear of the other brigades to relieve Croxton's Brigade, now out of ammunition. Here the 4th Indiana battery, attached to this brigade, met with an experience similar to that of the batteries of King's and Scribner's brigades. Upon the first advance of the enemy the brigade gave way and the battery was able to fire only a half dozen rounds before being overrun. Lieutenant Flansburg, commanding it, was wounded and captured, as were also many of the enlisted men. Five of the guns were captured, but subsequently retaken, and from the wreck a battery of four pieces was organized which did good service later in the day, and were the only guns out of the entire eighteen belonging to this division that were again brought into action, either on this or the following day.

The density of the woods in which the battle took place enabled the heavy masses of the enemy to approach unseen; the Federal brigades, moving to the front successively, were invariably driven back and the batteries allowed no time for limbering up. In the case of those that fell into the hands of the enemy, the loss of horses made it impossible for them to withdraw even though time had been afforded them for limbering.

The batteries being tied down to the movements of the brigades to which they were severally attached, were unable to select and occupy positions (such as there were) where they could act with greater effectiveness. Burnham's battery, with King's Brigade, fired but 16 shots; Van Pelt's, of Scribner's Brigade, but 64; and Flansburg's, of Starkweather's, only about half a dozen, before being overrun by the enemy; and the same thing happened to other batteries not yet mentioned. General Baird seems to have been aware of the impropriety of handling artillery in

this manner, but gives as a reason for so doing, that the batteries "could not be left behind for want of protection, and were therefore directed to follow closely the brigades, making their way through the trees." A battalion organization for his batteries, with an appropriate commander, would have relieved him from this embarrassment and at the same time afforded the batteries an opportunity of availing themselves of such advantages for efficient service as the field afforded.

Brannan's and Baird's divisions, although driven back from the positions where their brigades first encountered the enemy, turned several times as they retired and drove back their assailants, again, themselves, to be driven.

The troops first encountered by Brannan and Baird were those of Pegram's Division of Forrest's Cavalry Corps, which the night before had crossed the Chickamauga at Reed's bridge, and were now at Jay's steam saw-mill, about half a mile in front of the brigade. The cavalry was dismounted to fight as infantry; but it soon became apparent to Forrest that they were unable, alone, to hold the ground. He therefore called for reinforcements of infantry, and Wilson's Brigade of Walker's Division of Walker's Corps was hastened to his assistance, soon followed by Ector's Brigade of the same division, and these shortly afterwards by the brigades of Walthall and Govan of Liddell's Division of the same corps.

The presence of Thomas so far to the left of Crittenden, disarranged Bragg's plan. To meet this unexpected phase of affairs, he, too, had to resort to some movements of inversion. Walker's Corps was to have gone in on the left of Hood; now he, and all the troops that followed him, were on Hood's right, and were going in successively by divisions or brigades. Hood's attack was essentially made against the point originally intended; but instead of its being against the extreme Federal left, it fell, owing to the leftward movement of Rosecrans' troops, much nearer the right of the Federal position.

Walker, finding himself unable to hold his own, called for reinforcements. Cheatham's Division, of five brigades, of Polk's Corps, was the first to arrive.

According to his account he advanced his line of battle about noon, and soon encountered the Federal troops advancing rapidly in pursuit of Walker's troops; these he succeeded in checking and driving back for some distance, when his own troops were checked,

and in a short time forced to retire and await reinforcements. Cheatham seems to have had the same experience with artillery as had the Federals, for he reports losing one entire battery and part of another. But he adds, "The pieces and caissons were, however, subsequently recaptured."

These incidents are thus particularized to show the swaying back and forth nature of the struggle that took place in this dense forest.

That which has thus far been related was but the commencement of the first day's battle; that which follows being of a similar nature, will be even more condensed so as to bring it within JOURNAL limits.

When, as has been related, Brannan's and Baird's divisions arrived at the Kelly farm and faced towards the enemy, there was considerable interval between Baird's right and the left of Crittenden's Corps. To fill this gap, Johnson's Division of McCook's Corps was transferred from the right, arriving about 12 M., or some two hours after the battle had been in progress. Johnson immediately pushed his brigade into the woods on Baird's right and at once became hotly engaged.

Palmer's Division of Crittenden's Corps closed to the left on Johnson. After Palmer came, in the order named, the divisions of Reynolds, of Thomas' Corps; Van Cleve, of Crittenden's; Davis, of McCook's; Wood, of Crittenden's, and finally Sheridan, of McCook's Corps. Negley's Division of Thomas' Corps was held in reserve in rear of the centre of the line to give service wherever it might be needed. It will be observed that with the exception of Brannan's and Baird's divisions, no two adjoining each other belonged to the same corps; one of the fruits of the unfortunate tactical inversion heretofore animadverted upon. Brannan and Baird did not long continue together.

While these movements were in progress on the Federal side, similar movements were taking place with the Confederates. After the combined forces of Walker and Cheatham had been checked, as heretofore stated, Polk, commanding the Confederate right wing, was ordered to send Breckenridge's Division of his corps across the Chickamauga, and to proceed in person to direct matters on the right. Cleburne's Division of Hill's Corps was sent to report to Polk, and was hastened up to assist Walker and Cheatham to hold their ground. It came into the fight on Cheatham's left. Stewart's Division of Buckner's Corps was

moved up from the second line, and went in on the left of Cleburne and right of Hood.

The impetuosity of Stewart's attack, assisted by other troops, temporarily broke the Federal centre. Some of Hood's brigades were veterans of Longstreet's Corps from the Army of Virginia; other of Longstreet's brigades did not arrive in time to take part in the battle of the first day, and Longstreet himself did not arrive until late at night on that day.

Johnson's Division arrived at an opportune moment to check the enemy, who but a short time before had broken the brigades of King and Scribner of Baird's Division. His division consisted of the brigades of Willich, Baldwin and Dodge. The first two started into the fight together, but soon became separated. Dodge's was sent towards the right to assist Hazen's Brigade of Palmer's Division which had been closed in to aid Johnson. The brigades of Willich and Baldwin, moving forward, inclined to their left, enabling them to attack with vigor the flank of the enemy pursuing Baird's broken troops; at the same time Brannan attacking in front, the enemy was driven back, permitting Baird to rally his troops and reestablish his line.

Goodspeed's Ohio battery followed closely Willich's Brigade, but found opportunity for firing only a few rounds; it, however, rendered good service by furnishing horses to haul off five pieces which the brigade gallantly captured. Captain Simonson, commanding an Indiana battery attached to Baldwin's Brigade, fired about 130 rounds; but while retiring before the enemy lost one of his guns. Captain Grosskopff, commanding an Ohio battery accompanying Dodge's Brigade, was unable to fire at all until after the brigade had fallen back, at dark, to where the final stand was made, and then he fired only a few rounds. He did little or nothing the following day, and altogether proved himself an exception to the general rule of efficiency governing other battery commanders.

While Johnson's brigades were thus engaged, Palmer's Division of Crittenden's Corps came into the fight on Johnson's right. This division consisted of the brigades of Hazen, Cruft, and Grose, each with a battery; in fact the latter had two batteries, "H" and "M" of the 4th U. S. Artillery, each of four guns, commanded respectively by Lieutenants Cushing and Russell.

Palmer's brigades started in echelon from an open field near the

State road, but soon after entering the woods they became separated. Arriving abreast of Johnson they immediately became engaged in the terrific contest then going on at that part of the line. The enemy was pushed back a considerable distance, but fresh divisions coming up, Palmer's brigades were in turn forced back, and took position on a slight ridge which was held for some two hours, until the enemy, concentrating on that part of the field, swept everything before him back behind the State road.

In the meanwhile the batteries had had opportunity of doing some good work, as the ground here, being less wooded, was slightly more favorable for artillery than other parts of the field.

Hazen's Brigade, running short of ammunition, was relieved by Turchin's, and retiring beyond the State road, had just completed replenishing its boxes when it found itself in position to assist in repulsing the assault of the enemy which broke the line in front of this point.

Turchin's Brigade belonged to Reynolds' Division of Thomas' Corps, which, together with E. A. King's Brigade, Reynolds was conducting to the left to join Thomas. The other brigade—Wilder's, of this division—was acting as mounted infantry and not immediately present. The necessity appearing urgent to Reynolds, he arrested his further movement to the left and pushed in his two brigades to the assistance of Palmer's.

When Turchin went to the relief of Hazen, he was accompanied by Andrews' Indiana battery, of which he says: "The position on this day was so bad and so wooded that my battery could fire only three shots during the day's fighting, and these were fired at the rebel stragglers after we had made the charge."

Harris' Indiana battery, of E. A. King's Brigade, accompanying the latter into the woods, was able to fire a few rounds to assist its brigade in its severe contest, but had finally to fall back with it, minus one Napoleon gun.

Reynolds had been preceded by the two brigades of Van Cleve's Division of Crittenden's Corps; the third brigade had been left behind to guard the crossing at Lee and Gordon's mills. Arriving opposite Palmer's right, Van Cleve boldly pushed his two brigades into the woods, where they soon met the enemy, which they drove some distance, capturing four guns; but the enemy rallying recaptured the pieces, and drove back the brigades some distance. Van Cleve then rallying, forced back the enemy, capturing four other pieces, which he succeeded in bringing off.

Again he was driven back, but again rallying, drove the enemy until, overwhelmed by his masses, his brigades were broken and driven far to the rear. It was at this point that the enemy had concentrated his greatest efforts, and this was the supreme moment of peril during the battle of the first day. Here the enemy, driving everything before him, penetrated the Federal line, and was upon the point of breaking the army in twain when arrested in a manner soon to be related.

Stevens' Pennsylvania battery accompanied one of Van Cleve's brigades into the fight, and was enabled to do a small amount of firing, but lost four of its pieces in the final attack. These were, however, made good by adopting some of the guns captured from the enemy.

Swallow's Indiana battery did not accompany its brigade to the front, but remained near the road. Gen. Reynolds seeing it idle, placed it in position to form a nucleus for a new line should the front line be broken. To this he added Harris' battery when it came back from the front with the fragments of E. A. King's Brigade, as likewise two pieces of Lilly's battery belonging to Wilder's mounted brigade, which happened to be near by. The four remaining guns of this battery were a short distance to the right where they had an oblique fire upon the enemy towards their left. Almost adjoining Harris' battery on the left were Cushing's and Russell's batteries of the 4th U. S. Artillery and Cockrill's Ohio battery, which came back from the front and were gathered together and placed in position by Hazen. In addition there were several other guns, parts of other batteries, making altogether upwards of 30 pieces.

When the front line began to give way, as just related, the enemy followed up the success with great impetuosity. Reynolds says: "I met our retiring regiments in person, pointed them to 14 guns in position (those which he had stationed) as evidence that the enemy must be thrown back, and by great exertion succeeded in reforming several regiments in rear of the batteries. \* \* \* These batteries fired with terrible effect upon the enemy, his progress was checked, and our line for a time prevented from yielding any further. The enemy now shifted further to the right where there was evidently an opportunity in our line, and coming in on the flank our regiments again became disheartened and began to retire. The batteries following the regiments changed front and fired to the right, and the line was reformed along a fence nearly

perpendicular to its former position, with the batteries in the edge of the woods." Soon after this the enemy were entirely repulsed and the line reestablished, this time along or near the road.

Hazen, who, as before stated, was near this position with his brigade replenishing his ammunition, seeing the break, advanced his brigade, but was unable to withstand the enemy, who were pressing forward in mass. He says: "I found myself the only general officer upon that part of the field, and as to check the further advance of the enemy was of the utmost importance, I hastily gathered and placed in position all the artillery then in reach (the batteries before mentioned), in all about 20 pieces, and with the aid of all the mounted officers and soldiers I could find, succeeded in checking and rallying a sufficient number of straggling infantry to form a fair line in support of the artillery. My brigade could not be brought into position in time, there being but about two minutes to make these dispositions before the blow came, when the simultaneous opening of all the artillery with canister checked and put to rout the confronting columns of the enemy. It is due Lieutenants Baldwin, \* \* \* Cockerill, \* \* \* Cushing and Russell, \* \* \* commanding batteries, to state that for accuracy in manœuvring and firing their guns in the immediate presence of the enemy on this occasion, the army and country are placed under lasting obligations." The Confederate reports touching on this part of the battle are in harmony with the foregoing, establishing the fact that it was the firmness of these batteries that prevented them from reaping the advantages of victory on this occasion.

Most of the troops that caused this break were of Hood's Division which had arrived from Virginia in advance of its artillery. From this and other causes the Confederates had but few guns to reply to those just mentioned. Owing to the change of position of the contending forces the attack of Hood, intended originally to have been the first, became in reality the last.

Towards the Federal left the breach did not go beyond a portion of Palmer's Division; while on the right it included the divisions of Davis, Wood and all other troops as far as Sheridan's Division, which latter held the extreme right.

Davis' Division of McCook's Corps followed pretty shortly after Van Cleve, and immediately went forward into battle on the right of the latter. One of his brigades—that of Post, with its battery

—was absent guarding trains, leaving him but two, those of Carlin and Heg, for the fight. In passing Rosecrans' headquarters the battery of Heg's Brigade was left as a guard; that of Carlin's brigade—Hotchkiss' Minnesota—secured a favorable position in a small field on the right of the brigade, where it, together with four pieces of Lilly's battery of Wilder's mounted brigade, did good service until forced to retire with the infantry. Davis' Brigade fell back in confusion, but in due time was rallied behind the batteries established by Reynolds and Hazen. Hotchkiss' battery took position here also, and contributed its share in repulsing the enemy and restoring the broken centre.

About 3 P. M. Wood's Division of Crittenden's Corps and Barnes' Brigade of Van Cleve's Division, both of which had been guarding the crossing at Lee and Gordon's mills, were ordered to hasten down the road to join in the fight. Barnes was leading, and when opposite the right of Davis formed line and pushed through the jungle until he struck the enemy, when he, too, was forced to give way. His battery, the 3d Wisconsin commanded by Lieutenant Livingston, following closely, came into battery in the open field with Hotchkiss' battery, and with the latter fell back with the infantry and taking position on the further side of the road did good service. The brigade was rallied on the batteries.

Wood, following close after Barnes, sent one of his brigades—Harker's—into the woods to support Heg's of Davis' Division, which was now giving way. Harker, deeming his battery useless in such a position, directed it to remain behind where there was some open ground. Harker resolutely held his position and did splendid service, until, like those before him, he too was forced back. In the meanwhile Captain Bradley, commanding his battery, the 6th Ohio, "with," says Harker, "the eye of a true soldier, selecting the best ground in his vicinity, opened with telling effect upon the enemy, inspiring our own troops with confidence and causing dismay among the enemy. As our troops fell back the battery retired with prolonges fixed until it got a good position in the woods to the rear, where it was supported by our own troops. It here did great execution in repulsing the enemy, and remained in this position until I rejoined it."

Wood's other brigade—that of Buell—was scarcely formed to advance into the forest, "when," says Wood, "it was struck by a crowd of fugitives and swept away in the general *mélange*. The

whole brigade was carried off its feet. It was necessary for it to fall back across the narrow field on the western side of the road to the edge of the woods, under the cover of which it rallied."

Buell's battery—the 8th Indiana, Captain Estep—took position near the road. "A moment after this," says Estep, "and the battery was filled with men falling back in great confusion. I was compelled to cease firing till our men passed from my front. I thought I would then be able to deal a destructive fire on the advancing line of the enemy, but he was pressing so closely upon our line, delivering his fire as he advanced, his shots taking effect on my horses, I was compelled to retire my battery." In doing this he lost, temporarily, one of his pieces; the other five he moved back across the field to the edge of the wood into which his brigade had retired. Here he again opened fire, and with the other batteries, before mentioned, checked the enemy, who did not attempt pursuit over the open field.

"Order being restored," says Wood, "and a sufficiently solid formation acquired to warrant an advance, I led the brigade back in person, and reoccupied the ground from which it had been forced—the site on which it had been originally formed \* \* \*. In this advance a portion of Carlin's Brigade participated, led by General Carlin. Estep's battery, attached to Buell's Brigade, accompanied the advance. Scarcely had the lost ground been repossessed than the enemy emerged from the woods on the eastern side of the corn-field, and commence to cross it. He was formed in two lines, and advanced firing. The appearance of his force was large. Fortunately, reinforcements were at hand. A compact brigade of Sheridan's Division, not hitherto engaged, was at this moment crossing the field in rear of the position then occupied by Buell's brigade and the portion of Carlin's. This fresh brigade advanced handsomely into action, and joining its fire to that of the other troops, most materially aided in repelling a most dangerous attack. But this was not done until considerable loss had been inflicted on us. The enemy advanced near enough to cut down so many horses in Estep's battery that he could not bring off his guns; but as our infantry held its ground, they did not fall into the hands of the enemy." Estep, recovering his guns, restored his battery during the night to a fighting condition for the battle of the next day, in which he lost everything he had.

Wood's other brigade—Wagner's—together with its battery

was occupying Chattanooga, and consequently not engaged in the battle of either day.

The brigade of Sheridan's Division which Wood mentions as coming in so opportunely, was that of Bradley, which having formed on the road, "moved steadily forward across a piece of open level ground and ascended a gentle slope, when the enemy opened with a most withering fire of musketry, which cut down Colonel Bradley and his adjutant at the outset." This fire was replied to with such firmness as to cause the enemy to withdraw hastily, leaving behind Estep's battery, which he had captured. Prescott's Illinois battery, attached to Bradley's Brigade, had no opportunity of becoming engaged, nor did those of the other two brigades of Sheridan's Division.

At the time when the divisions of the left centre were giving way, that of Brannan, which had been so heavily engaged during the forenoon but was now comparatively idle, was hurried from its position on the extreme left to the assistance of the centre, and did some good service. During the night it took position in line between Reynolds on its left and Negley on its right. When it was withdrawn from the left of the line, Dodge's Brigade of Johnson's Division was moved around to the left of Baird to take its place.

In the movement of divisions from right to left, as has just been described, Negley's Division of Thomas' Corps had been left behind to cover the right flank of Rosecrans' position and the withdrawal of the trains by the roads leading through gaps in Missionary Ridge.

Some Federal cavalry was in observation still farther to the right and rear. During the forenoon Negley had some sharp fighting; late in the afternoon, being relieved by the cavalry, he moved his three brigades rapidly to the left, but was too late to become much engaged. By that time the enemy had been stayed and the broken line repaired. He now took position in line near the right of Reynolds, but during the night Brannan moved his division up between them. His batteries were with their brigades.

It was now becoming dark. The enemy, after his repulse before the centre, did not renew his attack in this quarter. Thomas had selected an advantageous position (that is, as advantageous as circumstances would admit of) for his wing, on a slight crest a few hundred yards in rear of the position then occupied by his troops. As the latter were withdrawing to it, the enemy made a

furious onslaught upon them but were repulsed with heavy loss. This closed the battle for the day. The troops, exhausted by day and night marching and the severe fighting, rested during the first part of the night, but towards morning began to cover themselves with such breastworks as they could improvise; that is, Thomas' wing did so. Those of the right wing were moved back and forth, without either getting into position or constructing intrenchments. McCook, Crittenden and Rosecrans himself were all on this part of the line, each giving orders, often conflicting.

Thomas' part of the line was a flattened crescent with its convexity towards the enemy; the extremities of the crescent rested on, or very near, the State road. It thus ran around the Kelly farm, and was established from fifty to a hundred yards within the woods that skirted the Kelly fields, which lay along the road for half a mile and were a quarter of a mile wide.

The enemy were busy during the night constructing breastworks, evidently fearful of unexpected attacks, or repulses in their attacks next morning.

During the day all of Rosecrans' troops had been hotly engaged except Negley's Division and two brigades of Sheridan's Division, and even these had had their skirmishes. This does not of course include Granger's three brigades at or near Rossville Gap. According to Confederate accounts, all of Bragg's troops were engaged except Breckenridge's Division and six brigades of other divisions. The carnage, as may well be supposed from such stubborn fighting, was very great, and the Confederates claimed the victory because they held the ground over which the fighting had taken place. But, while this was the fact, the events that took place on Thomas' front the next day showed that every pace to the rear had but strengthened his position. The only substantial advantage the enemy gained was a nearer approach to the State road towards Rossville Gap, which, if permanently in the hands of the enemy, would have proved truly a disaster to Rosecrans. The events of the following day will show that the whole of the Federal right wing should have been transferred during the night to the left of Thomas.

Although Bragg had failed in his plan to crush the Federal left and double the line back upon itself, his troops were now more in hand and more numerous than before, for another attempt. Rosecrans made no effort during the night to secure a better position; both his flanks continued in the air. The most

prominent features of the battle of the first day were purely accidental. Bragg's plan was to attack the Federal left at daylight; but the troops designated for this purpose did not get into position until long after this time, and were moving to do so when met by Croxton's Brigade, which under a misapprehension had been sent into the forest to investigate that part of the field. Croxton at once became engaged, and other brigades had to be sent to his assistance, and others, in succession to these, until the entire army was drawn into battle. Each brigade as it moved to the front struck the enemy and attacked vigorously, thus converting a defensive battle into one of attack. The enemy, meanwhile, was moving to the attack also, and this accounts for the peculiar direction assumed by the line of battle; the first brigades of the Federal left moved into the forest about a mile and a half, those that followed had successively less distance to go before coming upon the enemy—for he, too, was moving to the encounter—until, finally, the brigades on the extreme right did not have to move forward at all. Thus was given to the Federal line, along which the conflict raged, a position to the front of and oblique to that upon which it was intended to receive the attacks of the enemy.

While the Federal troops fought almost exclusively as distinct brigades, the Confederates engaged theirs more by divisions, but the density of the woods was such as to break these up more or less into separate brigades, and to convert the battle on their side also into one of brigades. The peculiar surging back and forth nature of the conflict was due to a combination of the foregoing causes.

The supreme crisis of the day happened when the centre was broken; and a fatal disaster was averted only by the batteries placed in position by Generals Reynolds and Hazen. Through the shaking up that the brigades got at this time the batteries were freed from the brigades to which they were attached, and were therefore available to be massed to meet the emergency. What they then did forcibly illustrates two very important features in the use of field batteries: one of which is, that they should be kept together in groups as much as possible, so that their combined fire may have, as it had in this case, a telling effect wherever delivered; the other is that batteries, thus grouped, constitute a firm basis upon which broken troops may be rallied. It was, however, a sad commentary upon the system of organiza-

tion, or method, adopted for the artillery of that army, that a division and a brigade commander had to leave their own important functions at such a time to attend to duty which under a proper system would have been performed by an artillery commander.

As soon as the crisis was over the batteries rejoined their brigades to continue to follow them through the vicissitudes of the battle of the following day, but without a like opportunity of giving evidence of their capabilities.

The brigades to which the batteries were attached, averaged only about 1460 muskets on the line of battle. Brigade commanders, whenever practicable, placed their batteries in the centre of this short line, but often the batteries were broken by having regiments posted between their platoons. Not only was the effectiveness of the artillery fire impaired by this system, but the solidity of the infantry line destroyed, a fact substantiated by the reports of division, brigade and regimental commanders. The reports of these commanders are curious as showing the extraordinary manner in which their commands became broken into detachments and intermingled, artillery and infantry, each in the way of the other, to the confusion and hindrance of both. Under such circumstances it was impossible for batteries to do much really valuable work, or more than was done on this day.

Owing to the density of the woods and the scarcity of roads leading through it, the enemy was able to bring into action only a limited number of his batteries, but these, owing to the battalion system adopted by Bragg, were at least kept from impairing the efficiency of his infantry.

The Federal right wing, after repulsing the enemy that had pushed it back across the State road, was not again brought forward into line with the left wing under Thomas, but bivouacked for the night to the westward of the road. Thomas' right rested on the road, from which it bowed in a compact line around to the eastward, until it almost reached the same road again to the northward of the Kelly house and fields.

## WATER SUPPLY IN DESERT CAMPAIGNS.

By LIEUT. CHARLES L. BECKURTS, SIXTH U. S. INFANTRY.

GENERAL WOLSELEY in the Soudan campaign for the relief of General Gordon selected as his line of advance the circuitous route along the windings of the Nile. Berber could have been reached more directly by taking steamers to Suakin, and thence marching 240 miles across the country from the Red Sea.

Once having reached Berber the advance up the Nile to Khartoum is comparatively easy. A large army could not, however, be conducted over the almost waterless route between Suakin and Berber, except in small successive detachments, which would not have been practicable.

For the same reason, the great bend of the Nile from Korosko to Abou Hammed, a distance of 230 miles, could not be crossed by a large army.

The advance along the Nile proved so difficult and so slow that attention was turned, though hopelessly, to the desert routes.

On this side of the ocean, General E. L. Molineux, a distinguished American soldier, advanced the ingenious theory, that the successful conduct of such desert campaigns could be accomplished by the introduction of the American system of pipe lines, the pipe to be laid by the troops as they advance, and left permanently for the future use of caravans.

Thus a device of obvious military value would be of lasting value to future commerce.

The practicability of the scheme could not be doubted, for at the time, the National Transit Company was piping oil from wells in West-Virginia and in Pennsylvania, 400 miles or more, across the Alleghany Mountains to tide water in New York Harbor.

In the campaign referred to, a narrow gauge railroad from Suakin to Berber was projected, but the scheme was either postponed or abandoned.

Leaving out of the question the expense of constructing and maintaining a railroad, time was also a very important factor.

Five or six-inch pipe can be laid at the average rate of a mile a day by an ordinary gang of twelve men.

It is said that four-inch pipe can be laid for fifty miles in a day by 1000 ordinary, unskilled laborers—provided that the pipe is first delivered along the line where needed.

The pipe could, therefore, have been easily laid at the rate of ten miles per day, by the troops as they advanced.


Aside from any military importance, such a pipe line is important to any European power that wishes, by short commercial routes, to control the trade of the Soudan.

The desert between Korosko and Abou Hammed consists about equally of hills and open deserts. The hills lie in the northern portion and do not average more than from 500 to 700 feet in height. They are grouped in an irregular manner and have no well defined axis.

The route through the hills passes from one little valley to another, where there is shadow for a great portion of the day. The hills are not hard to climb, are flat on their tops, and command the passes. The deserts are largely composed of a soft conglomerate mixture of baked loam and pebbles, with occasional drifts of pure sand, outcroppings of marble, and blueish granite.

Water is very scarce and the little obtainable is bitter and bad. Abou Hammed is at least 800 feet higher above the sea level than Korosko, and allowing for necessary windings and variations of grade, the route required for the pipe line would have been 300 miles in length. The force under General Wolseley would have required a minimum daily allowance of 36,000 gallons, and two days' supply should be kept on hand for emergencies. The above amount of water could be easily supplied through a four-inch pipe.

Owing to the lack of fuel on the route, it would at first be necessary to force the water through the entire distance by head, or pressure.

As Korosko is 800 feet lower than Abou Hammed, a very great head or pressure would be required to overcome the inequality and great friction in so long a distance. The pipe should be laid in successive short curves, , in order to allow for expansion and contraction. In case the sand is blown out from under the pipe, the curved method of laying will allow it to settle without breaking.

The danger of the supply being cut off, and the difficulty of

guarding the pipe, is infinitely less than in the case of a railroad, and it is very much easier to repair.

It would be necessary to detail a strong body to construct guard stations and reservoirs along the line at intervals of a day's march. If the enemy succeeded in cutting the line, the safety of the troops, if forced to retreat, would be assured as far as water is concerned.

General Wolseley could have reduced the difficulty of guarding the line by subsidizing and enlisting the services of the desert tribes. If the tribes could have been paid, partly in money and partly in water, from the tangible benefit received, they would become all the more interested in guarding the pipe line.

Whenever practicable the reservoirs should be enlarged.

The line could have been laid in sections of 30 or 50 miles, each terminal station creating a base of supplies for the advance section, and the work pushed on to rapid completion.

With the exception of the guards for the stations, the main body could have remained near Korosko. Having once successfully completed the pipe to Abou Hammed, advantage should be taken of the natural flow of the water, and the difficulty in regard to pressure would disappear. The permanent pumping station would then be shifted to Abou Hammed, and the effective run of the pipe greatly increased.

Once at Abou Hammed, the river route through Berber to Khartoum is sufficiently direct. Berber may be described as the gateway to the Soudan—healthily situated and abounding in supplies.

It is located on flat and open land, and can be fortified.

The line through Khartoum, Berber, Abou Hammed, with a pipe line across the Nubian desert, creates a practicable highway from Cairo to the Soudan. To American ingenuity and American enterprise all credit is due for the practicability of such a scheme. To General Molineux is due the credit of first suggesting the adaptability of the pipe line to military purposes.

#### AUTHORITY.

Daily papers, year 1884.

Manuscripts.

NOTE. To pump 36,000 galls. water, per 24 hours, against a pressure of 1000 lbs. per sq. in. at the pump, would require an improved Duplex Plunger "Oil Line" Pump weighing about 7500 lbs. A 30 horse power boiler to run the pump would be required, and a No. 1½ "Blake" Pump to feed the boiler.

Total weight of pumping plant 13,800 lbs. Fuel consumption about 200 lbs. coal per hour. Speed not exceeding 40 ft. piston travel per minute.

## SKOBELEFF'S LAST CAMPAIGN.\*

BY CAPT. CHARLES H. CLARK, ORDNANCE DEPARTMENT U. S. A.

YOUR attention is invited for a short time this evening to the consideration of the last campaign planned and fought by this illustrious young Russian general, who had won a world-wide renown during the Turkish War as a tireless fighter and skillful commander.

As his earlier reputation and successes had been gained in Central Asia, so he was there to conduct his final military operations, and win his final successes by the overthrow and subjugation of Turkomania's most powerful tribe.

The campaign affords an extremely interesting study, and is valuable as an example of serious difficulties patiently overcome; for its display of most thorough knowledge of a treacherous and wily enemy, in many ways strangely resembling our most warlike Indian tribes; and it presents also an instance of complete and satisfactory triumph of civilization and its methods over those barbaric. It gives, besides, one of the few illustrations of regular siege operations undertaken in the more recent of modern wars.

The tribe of Turkomans known as *Tekkés* was to give the last serious resistance in Central Asia to the rule of the great "White Tsar." This tribe was subdivided into the Mervli, or inhabitants of Merve, and the Akhal Tekkés. The latter were to bear the principal burden of this campaign, but they received much willing and substantial aid from their brethern in Merve.

Vambery† in 1863, estimated the entire *Tekké* tribe at 60,000 tents. O'Donovan‡ in 1881, considered the population of Merve alone as "close upon half a million." Marvin§ states that in the Akhal Tekké fortress, during the campaign under consideration, there were assembled 40,000 *families*. In such a nation, with a very large proportion of fighting men, to a great extent mounted, the resistance to be expected afforded at the outset food for very

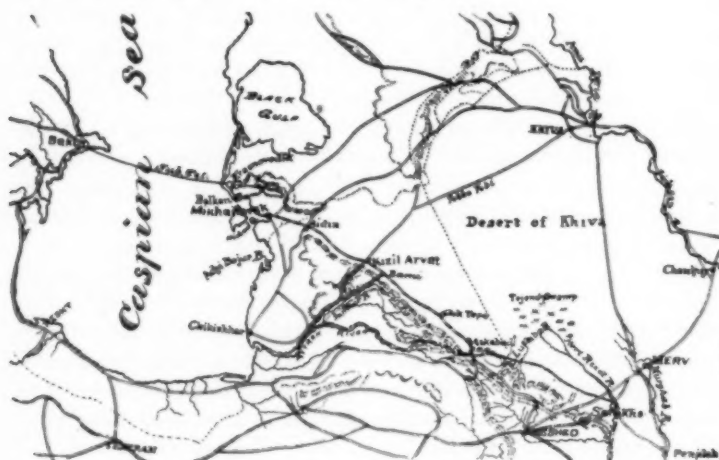
\*Read before the Vancouver Branch, M. S. I., January 5, 1891.

† "Travels in Central Asia."

‡ "The Merve Oasis," Vol. II, p. 499.

§ "Russians at the Gates of Herat."

serious reflection. During the debates on Candahar, Lord Salisbury said that he had always believed that the Turkoman barrier would last his lifetime.\* Even in Russia so severe was the resistance apprehended that General Tergoukasoff, Skobelev's predecessor, did not think that the barrier could be broken with less than three years hard fighting.\* The situation of these Turkomans in the desert had for many years shielded them from the punishment they so richly deserved. The oasis of the Akhal Tekkés, flanked on one side by an extensive desert and on the other by mountains having few practicable passes, had but one approach over a long narrow line, much of the way waterless, and during military movements not easily defended. (See Map I.)



MAP NO. I.

This oasis extended in a long narrow strip for more than 13 miles, varying in width from 3 to 6 miles. The villages were scattered over it according to the location of water. Wherever rivulets trickled down from the mountains were found wheat fields and fruit trees. Land, without the water for its irrigation was worthless, becoming at once a desert waste. Here and there among the trees were gray clay huts, with small towers connected by a chain of clay walls and trenches. These inclosures afforded protection to the people and their flocks from frequent forays of warlike neighbors, and it will be found a little later that these exer-

\* "Russians at the Gates of Herat."

cised a considerable influence on all the active operations of the campaign.

The Akhal Tekkés, using this oasis as a secure retreat, with their horses of remarkable speed and inured to the fatigue and thirst of long desert rides, accustomed to lie in hiding during the day in some retreat overlooking a mountain pass, or concealed in ancient ruins on the line of some desert route, would strike, usually at the first gray of dawn, some unsuspecting caravan or ill-guarded outpost, rob, murder, pillage, and then vanish in the trackless deserts.

These surprises were pushed with such impetuosity as to tax the strength even of a regular army, but the average Asiatic soldier could hardly withstand them even under the most favorable conditions.\*

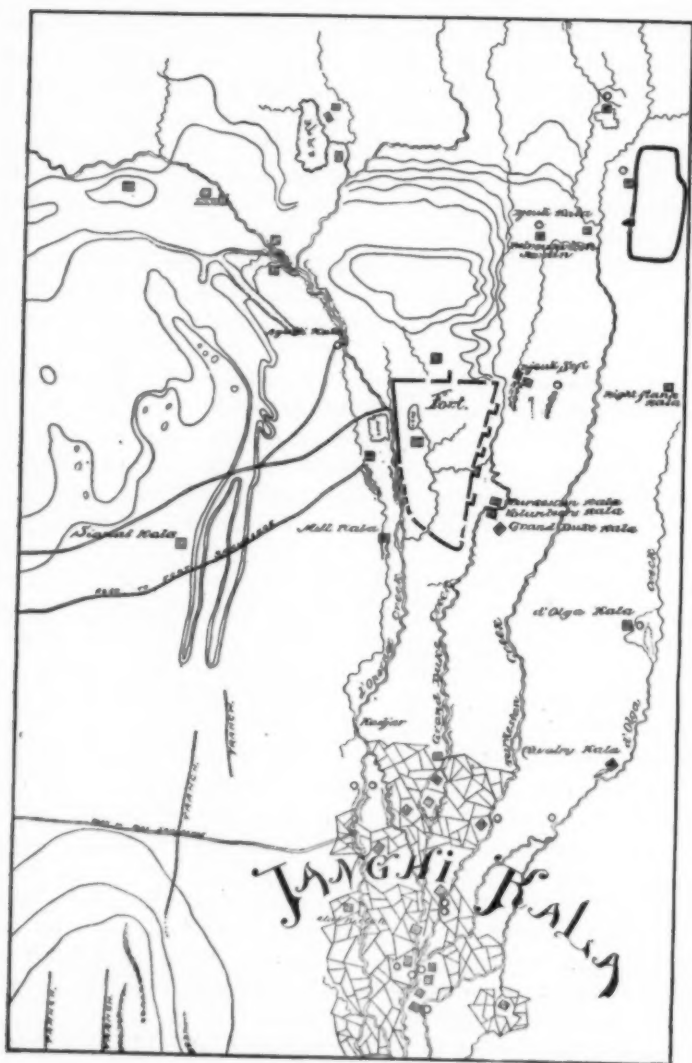
In 1879, after years of desultory fighting, a large Russian expedition was sent against the Akhal Tekkés.

From contact with the Russians and from their own mode of life and surroundings, the Tekkés had imbibed certain notions of the value of fortifications, and they were found shut up with their families and flocks in an immense earthen fortress located in the heart of the oasis.

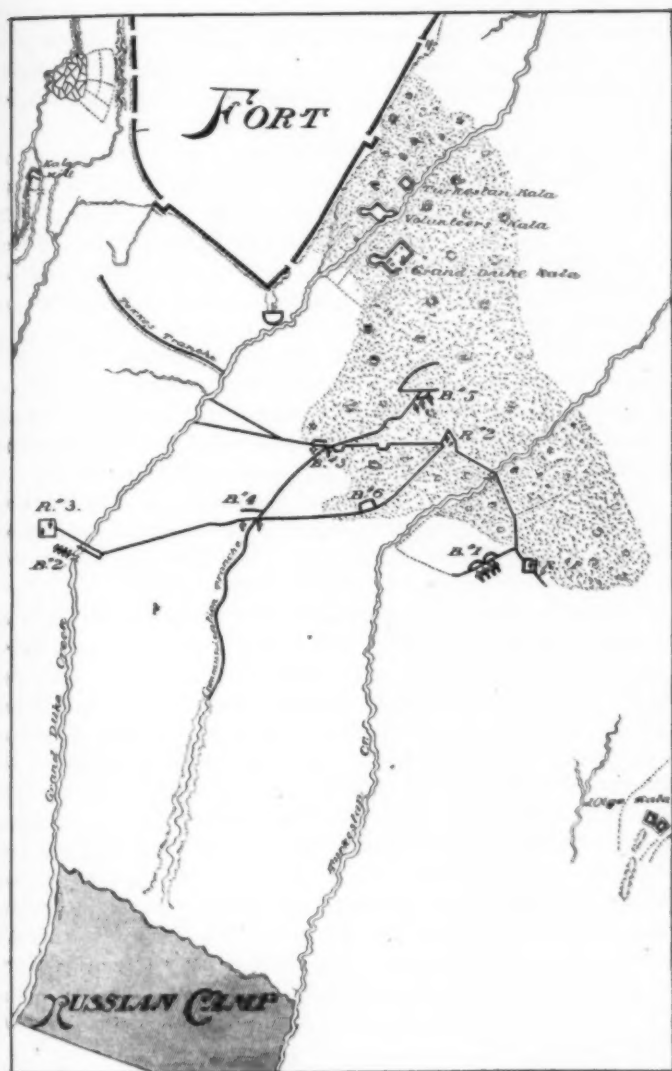
This is the far famed Géok Tépé. The fort (see Maps II and III) was in the form of a trapezium, the longest face being about 1650 yards. The interior space according to estimate of Verestchagin was about 850 acres. The ramparts were constructed in straight lines with no flanking defenses, but provided on all sides with long covering traverses. The walls were of clay, about twenty feet in height and twenty in thickness. The ditch was wide and deep, and in many places filled with water. Near the centre of the inclosure was a huge mound on which was found mounted a brass piece probably captured from the Persians. This fortress afforded a safe place of refuge, and on the approach of hostile columns the mounted warriors could sally forth for raids and reconnaissances, during which they picked off many an unwary or exposed detachment. It was too strong to be taken by open assault, and too extensive to be regularly surrounded except by an exceedingly large besieging force.

The expedition of 1879 attempted to storm this stronghold, but signally failed after much bloodshed, and retreated with great

\* For example of night attack, see *Harper's Magazine* for Jan. 1890, "The Russian Army."



MAP NO. II.



MAP NO. III.

loss. The prestige of the "*white caps*" had been badly shaken, and it became absolutely necessary, if Russia wished to maintain her hard-earned conquest in other parts of Central Asia, that this disgrace should be washed out with torrents of Tekké blood. Russia could not hazard another defeat. That would have been irreparable.

So in this hour of need, among the few in whose hands the honor of Russia could with perfect confidence be trusted, Skobelev stood preëminent. His thorough acquaintance with the country, its people, and their mode of fighting; his untiring energy, careful supervision of details, and reputation for striking rapid and decisive blows, insured success for his leadership as none other could.

He was given *carte blanche* as to men and means.

The first and perhaps most important part of the problem consisted in the carrying forward through the desert to some selected point, with all possible speed and in the largest possible quantities, the various necessary supplies and artillery stores.

Bami was selected as the place of concentration, the original bases being two points on the Caspian Sea, Tchikishlar and Mikhailovsk Bay. The roads from these points met at or near Bami, one running along the Attrek and Sumbar rivers and over a low spur of the Kopet Dagh; the other across the desert. In the expedition of the previous year the Attrek road had alone been used, and the provisions were consumed by the troops in front faster than they could be pushed forward by camel transport from the base in rear. Then the harbor at Tchikishlar had proved a very poor one, and the difficulty of landing stores so great that there had resulted great delay and insufficiency of supplies at the base itself. Now a second and better base had been selected on Mikhailovsk Bay, but the road from here to Bami ran for more than 200 miles over an almost waterless desert. To overcome this obstacle a narrow gauge railway\* was commenced with some unused material left over from the Turkish War. As rapidly as it was constructed, it served to carry water, provisions and supplies to troops marching by this line. Either line was subject to raids from the alert and rapidly moving bodies of Turkoman horse.

At Bami, then, stores were to be collected, troops assembled,

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\*This road now runs through to Merve and on north to Samarcand, a distance of about 900 miles.

and, finally, everything being in readiness, the advance made. It was necessary to send here first only the troops absolutely necessary to protect the stores. The consumption of food supplies had to be reduced to a minimum.

This lesson had been learned from the bad management of the previous ill-fated expedition.

There were to be collected in *Bami* as follows :

6 months provisions for 8000 men.

15,000 battering charges and projectiles.

2,000,000 small-arm cartridges.

Work on this commenced in June, 1880, and was not completed for six months. Camel trains under strong escort were going untiringly back and forth over the lower route. After two months the upper route was also used.

Meanwhile, Skobelev with the advance detachments was far from being idle. On the first of July, at sunset, with a mixed force of 800\* men, he started out for a reconnaissance. Some features of this were so remarkable as to deserve more than passing notice.

Its object was to view the prospective field of operations, burn standing grain, capture cattle, destroy villages, and in short, inflict as much damage as possible.

It had become above all necessary to inspire the enemy with some fear, as he was becoming "audacious" and threatening an attack.

It was understood in the detachment that it was simply a reconnaissance, but Verestchagin† says, "still, every one who was acquainted with Skobelev's character, and had been in battle with him, could prophesy that he would not confine himself to a mere peaceful ride, and that he would infallibly desire to come into conflict with the enemy, or, as 'Mikhail Dimitryvitch' was fond of putting it, 'draw fire.'"

The enemy kept retreating and abandoning the villages until the Russians reached a walled inclosure or cattle-fold between 6 and 7 miles from Géok Tépé.

\* 3 Companies of Infantry.

4 Companies of Cossacks.

4 9-pdr. long range guns.

4 Marching guns.

Mounted light gun detachment and rocket company.

† "At Home and in War," by Col. Alexander Verestchagin ; T. Y. Crowell & Co., New York, Publishers.

Here the swarms of Turkomans could first be seen pouring from their fortress. From remarks overheard by Verestchagin, it was evident that both officers and men began to feel that they were in a rather precarious situation. Here was a little band of only 800 stout-hearted Russians, while in and about that distant and gloomy fortress was a host of 40,000 Turkomans, a large proportion being bold, brave, and skillful horsemen.

One foot soldier, as he crosses himself, says, gently, in a low tone: "May the Lord help our general to get out of this safe and sound! They are so strong that they throng and throng until there is no end to them."

Early next morning, Verestchagin was left in the walled inclosure with all the impedimenta, grooms, orderlies, servants, the sick and weak, with half a company and some machine guns. His verbal orders received the night before from Skobelev were as follows: "You will remain here, shut yourself up in this cattle-fold with your command, and in case of attack, you must defend it at any cost. I rely upon you. Do not forget that the Kala serves as our base. Here are your orders [written]. Go, busy yourself with fortifying it and clearing off an esplanade."

The main body in compact column, so disposed that it could be quickly faced in any desired direction, moved off to make the close acquaintance of their wily enemy, under the very shadow of the famous stronghold.

It is a stirring spectacle of war as Verestchagin paints it from his overlooking retreat. The brave little detachment is soon surrounded by swarms of Tekké horsemen, who seem wild with delight that such a splendid prey is marching straight into their hands. To keep them off, the artillery is repeatedly called into play and the spectators see "the fires of cannon flashing in all directions, and puffs of smoke rising from a dark spot surrounded by scattered horsemen."

Verestchagin says that no battle during the Turkish campaign ever produced such an impression upon him. It seemed as though the little column was marching into the very jaws of death, and the reputation for bravery and daring of these wonderful Tekké horsemen tended to inspire dread fears in the hearts of the detachment.

The Tekkés are about them in dense throngs; "their knives are in their teeth, their sabres bared and gleaming in the sun." Confidence is only maintained under the eye of their brave and

beloved commander. Then the thought of what might occur if anything should happen to him adds fresh fears. He is now showing in a daring way his most thorough knowledge of the enemy. He has studied the Asiatics thoroughly, and is convinced that a strong, compact detachment, even though small, can by well directed volleys stand off the swarms of Tekkés, who are not acting sufficiently in concert, and seem unable to determine on the *charge*, which would inevitably, though at some sacrifice, annihilate this little band of Russians. They are reluctant to sacrifice their beautiful and matchless horses, and would delay the seizing of their prey until some unforeseen accident shall disconcert for a moment their disciplined foes, or until they can, possibly under cover of darkness, gain the advantage of a surprise. The very coolness and machine-like movements of the detachment disconcert and puzzle them.

The column slowly makes its way into the oasis, disappears over the crest of the hills, and is for many hours lost to sight.

Then it reappears, still surrounded by the swarms of Tekké horse, swooping and howling "like infuriated dogs around an exhausted victim." The division marches in the same compact dense line, and, as before, firing in all directions. The enemy is finally compelled to relinquish for this occasion all hope of conquering the cool steadfastness of these brave Russian soldiers, who take refuge for the night in the cattle inclosure.

Skobelev is much pleased with the result of the reconnaissance and says to Verestchagin: "The enemy is dangerous, my dear fellow, dangerous, but they had not the courage to fling themselves upon us, sabre in hand, and carry the attack to a conclusion."

It hardly need be added that there could have been in such a case but one *conclusion*, considering the disparity in numbers, and *that* the complete annihilation of the Russians.

The entire conception and execution of this reconnaissance was most thoroughly like Skobelev—bold, brilliant, dangerous, theatrical, but approved, after all, with the undeniable stamp of success. He had sent no trusted representative to bear the burden of it all. None were so well fitted for it as himself. He had come himself, seen for himself, and a little later, in his own good time, would conquer and punish these defiant robbers of the desert in a way they would long remember. The whistling of hostile bullets seemed to be but a refreshing stimulant for Sko-

beleff, and he had that day shown an example of nerve and cool courage seldom equalled and rarely excelled.

It seems remarkable that all through his wonderful career Skobelev should have repeatedly and almost whenever the opportunity offered exposed himself in the most reckless and conspicuous manner, wearing white and mounted on a gray or white charger, and still escape serious wounds or sudden death. Greene states that this was always done with a cool, determined purpose, and that he went through the Turkish War with the idea strongly fixed in his mind that he would never see the end of it. Almost his first words on hearing of the armistice were, "Well, perhaps I won't get killed after all."

That night the Tekkés turned out in strong force to venture in the darkness an attack which they had seemed afraid to precipitate in the day-time, but they found the Russians alert, and meeting with a warm reception did not push the assault with much energy.

Next day, the brave little detachment having accomplished the purposes of the reconnaissance, set out on its return and reached *Bami* without event worthy of note.

It will be remembered that this took place early in July.

The accumulation of troops and stores at *Bami* progressed without interruption until the end of November. During June and July the stores were conveyed by the *Attrek* line alone.

It was now determined to transfer the base to a point much nearer the Tekké fortress, and the place selected was the *kala*, or cattle-fold and inclosed gardens, a little over six miles from the Tekké fortress, already mentioned as occupied during the reconnaissance. This was named by the Russians "Fort Samurskoe," and as such will be referred to hereafter.

Troops to the number of 2000 with 20 guns pushed forward under Skobelev, occupied the *kala* without serious resistance, and the work of fortifying and establishing depots immediately commenced. From this time on transport trains and troops marched in daily.

On December 16th, Kuropatkine arrived with the Turkestan contingent of 1000 men from General Kaufmann. They had come from *Khiva*, via the *Artakui* wells and *Bami*.

This detachment had traversed about 600 miles, 500 of the distance being through a sandy, stony wilderness, waterless to such a degree that the 900 camels belonging to the outfit were only

watered twice during the whole of this distance. The average length of fourteen marches through the desert had been 36 versts (23.86 miles). They travelled day and night. Only two men were ill on the way. The rest arrived quite fresh. Skobelev praised them heartily for their brisk, healthy looks and good condition, judging from which it was hard to believe that the detachment had reached Samurskoe by forced marches extending over nearly 600 miles.

On the 4th of December a reconnaissance had been made to sketch the *kalas* near the main fortress, as these were to play an important part in the preliminary operations for the reduction. This met with considerable resistance, but the engineers succeeded in obtaining sketches of the villages of *Yanghi* and *Opernoé*, as had been the intention.

Verestchagin, who accompanied this reconnaissance, thus gives his first impressions of the Turkoman stronghold.

"But Géok Tépé is a big fortress. Away yonder its end reaches the very desert, two versts long to my calculation, as I gaze through my field-glass at the lofty clay walls. And how thick they must be. A horseman is riding along them yonder; now he descends, and a moment later, rises into sight in another place. The Tekintzi make their appearance from behind the walls, now here, now there, in crowds. Through the glass it is possible to get a good look at their faces, garments, and weapons. There is a multitude of Tekintzi. Long poles with iron points are in the hands of some of them in the place of guns.

\* \* \* \* \*

"The sun was already far lower than the zenith when we began our retreat to Samurskoe. The enemy had, evidently, only been waiting for this. A frightful howl and shout arose. Thousands dashed out of the fortress, both horsemen and foot soldiers, and encircled the detachment on all sides. Two hundred Cossacks dispersed in a semi-circular chain in the rear guard and on the flanks, and exchanged shots with the enemy without dismounting. In addition to this, a company of infantry marched in the rear guard, halting continually and delivering volleys. Both the Cossack companies and the infantry formed a sort of line, beyond which the enemy could not penetrate nearer to the detachment.

"The sun has disappeared, darkness is descending. But now the moon rises out of the desert, and beams with a silvery greenish

light. The Tekintzi pursue us more obstinately, more boldly than ever.

\* \* \* \* \*

"The General despatches Cossacks with frequent orders; now not to lag behind but to keep closer to the detachment; again, on the contrary, to hold the enemy back more vigorously. The detachment marches very slowly. It is obliged to halt every moment and fire. The picture of our retreat was remarkably effective beneath the brilliant moonlight. In front, the compact mass of the detachment was dimly visible; on the sides the rear guard, in the line of sentinels the Cossacks, and the flashes running along like a fiery serpent.

"In the extreme rear of the company, long streaks of fire flash up every moment. Volleys thunder through the silence of the night. \* \* Through the fire and smoke, I see Skobelev wheel round sharply on his gray horse, ride round his soldiers and encourage them; they can be heard to answer him: 'Glad to fight, your excellency,'—when, all of a sudden, in the midst of this all, utter darkness sets in; the moon disappears—an eclipse of the moon is taking place. The Tekintzi, being Musselmans, take this as a bad sign, and, stupefied by this ominous phenomenon against them, cease to fire. Our discharges cease also, and amid profound silence, in a darkness that can almost be felt, we reach Samurskoe without firing a shot. It proved that we had *four* soldiers killed and nineteen wounded, among the number two officers."

On the arrival of Kuropatkine (December 16) nearly all the forces which Skobelev could dispose for the storming of Géok Tépé were assembled—in all 6000 infantry and 2000 cavalry and artillery. At this time the troops were being daily practised in escalading drill over deep ditches and breastworks of formidable profile, and the sappers and working parties of the line were busily employed making up gabions, fascines, scaling ladders, etc.

On the 15th took place what was nicknamed by the Russians a "General reconnaissance" on account of the number of general officers taking part therein. Its object was to acquaint all the corps commanders with the locality over which their men would have to act on the day of the attack on Yanghi kala, a large village near Géok Tépé. This village was situated on a beautiful stream, forming an excellent emplacement from which to undertake the siege of the stronghold.

On December 20th, Skobelev's little army set out in light

marching order to take up its position before the fortress, preparatory to the commencement of the regular siege operations which had been determined on as absolutely necessary.

Two regiments and two companies of Cossacks were left at Samurskoe, under command of Verestchagin, to guard stores and protect the base. From this time on constant communication was kept up with the base, baggage trains under convoy of small detachments taking back the sick and wounded, returning with ammunition and their supplies.

Verestchagin remained in command until shortly before the final assault, when Skobelev sent for him to take part therein.

#### PART II. SIEGE OPERATIONS.

For the details of these operations we are indebted to accounts of Russian officers, one translated and published in *Colburns United Service Magazine* in 1881, and the second, on which principal reliance has been placed, a detailed report made by a Russian Engineer officer, and published in several numbers of the *Revue Militaire* for 1885.\* The limited time allows consideration only of the more salient features of these operations.

The position of Yanghi kala was taken possession of without great difficulty.

The following work was planned to follow:

1st. To collect enough artillery and rifle ammunition for the siege, and provisions for one month.

2d. To reconnoitre the ground close up to the walls, so as to enable the military engineers to lay down a definite scheme of siege works.

3d. To scour the country for forage.

The early operations in connection with the siege works consisted in the opening of the parallels, construction of batteries for enfilading the east and south fronts, and of a mortar battery to act against the group of kalas situated near the southeast angle of the citadel, and forming the position called that of the "Grand Duke."

The southeast angle of the fortress had been selected for attack by regular approaches.

The artillery was to play an unimportant rôle until the capture of the position of the "Grand Duke."

\* All dates are made to correspond with our calendar.

The Russians were to have at their disposal only 20,000 projectiles, 16,000 already on hand and 4000 expected a little later. As a new centre of resistance could be formed at Askhabad after the capture of Géok Tépé, Skobelev resolved to expend here only 12,500 projectiles. This restricted number imposed great caution in the employment of the artillery.

Skobelev always had the fear, which he retained, moreover, during the entire siege, of seeing the Tekkés leave their citadel during the night and seek safety in flight.

To guard against this he determined to occupy with a portion of the cavalry some point from which might be watched and menaced their line of retreat into the desert. The position selected was the *kala* of the "Right Flank."

Hearing a great commotion in the citadel at one o'clock on the morning of December 22d, he ordered General Petrusevitch to set out immediately with the cavalry and a platoon of mountain horse-artillery. They arrived at the "Right Flank" *kala* at 5.30 A. M., and set out from there at 6.45 for the position now referred to as the "Garden of Petrusevitch." This point is situated at the junction of two arms of the "Sekiz-Yab," and consists of an extended eminence, having the form of an irregular quadrilateral, surrounded by clay walls about 6.8 feet in height. Inside this *enceinte* was a small *kala* surrounded by walls 14 feet high, and with a massive gate in the west face. The entire surface of the eminence was divided into irregular polygons by low clay walls, and the approaches were very uneven.

The column of Petrusevitch advanced, covered at fifty paces by a line of scouts. Everything was quiet. Daylight appeared, but the fog was intense and did not permit seeing any distance. Arriving at 150 paces from the northeast angle of the eminence, the head of the column was fired upon. Petrusevitch dismounted and rushed to the assault at the head of his troops.

He fell mortally wounded. The Russians drove the Tekkés at the point of the bayonet beyond the interior walls.

Then followed a desperate and fluctuating fight, during which the body of Petrusevitch was several times taken and retaken. The Russians finally drove out or annihilated the Tekkés who occupied the inclosure nearest the outer wall, but other inclosures and the *kala* remained in the hands of their adversaries. The Russians had already 50 men killed and wounded, of whom three were officers.

To complicate matters, the Tekké horsemen had first appeared from the citadel, and then recoiled and returned under the fire of the mountain guns and musketry of the reserve. The Tekké infantry now began to appear. Cartridges were giving out and the artillery had no more ammunition.

Everything was in the possession of the Russians except the interior kala, the massive gate of which could only be forced by the artillery.

Reinforcements of foot troops had been pushed forward from the "Right Flank" kala, and, protected by these, the assaulting column withdrew, bearing its dead and wounded (3 officers and 12 men killed, and 1 officer and 37 men wounded).

The attempt to cut off the Tekkés from the desert had then proved abortive. Moreover the combat produced upon the Russians a very depressing effect. The siege works were progressing as rapidly as the limited number of workmen would permit. Numerous necessary details reduced this number to 1250.

The works preliminary to opening the 1st parallel (Siege Battery No. 1 and Redoubt No. 1) were commenced at a distance of about 1400 yards from the objective point—the southeast angle of the citadel. The first parallel was commenced at 450 paces in advance of Battery No. 1.

The companies charged with the protection of the workmen were under cover behind a low clay wall running along the "Turkestan" Creek.

The 2d parallel was to follow the outline of the ditch and to be as near it as possible.

The 1st parallel rested on the left on the "Stavropol Redoubt" (No. 3), and on the right on "Redoubt No. 2," connected to the rear with, and supported by, another smaller redoubt known as No. 1. The advance position at the "Right Flank" kala served to strengthen this line.

The parallels were to be closely connected by the usual trenches and approaches, sunken breaching batteries being constructed at certain favorable points. Such plan of attack was deemed sufficient in view of the deficiency of the enemy in artillery, he having but one gun.

In the early stages the Russians were not interfered with in their labors, and, besides, the attention of the enemy was attracted towards the "Petrusevitch" garden.

When affairs had become quiet in that quarter after the dis-

comfiture of the Russians, the Tekkés opened on the workmen and protecting troops a musketry fire, slow at first, but increasing in intensity little by little, especially upon the left flank, where the Tekkés occupied the "Mill" kala and a trench dug by them in advance of the *enceinte* of the citadel. The only cannon of the defenders directed its fire also on this side. The Russians reinforced the infantry troops protecting the workmen, and half of a mountain battery placed in Battery No. 2 opened fire upon the enemy occupying the "Mill" kala. This kala, and the ground surrounding it, taken in connection with the trench just referred to, afforded for the Tekkés an extensive *place of arms*, where they could mass and threaten the Russian left flank.

The principal effort was to be on the right of the Russian attack, the opposite side having only a secondary importance until the occupation on the right of the position of the "Grand Duke."

The assignments for labor, trench guards, etc., was very burdensome on the Russian troops during the entire siege. Moreover, on leaving the works, the fractions which had been employed did not enjoy complete repose, for they had to furnish detachments to protect trains going after forage, and to accompany convoys going and coming between Fort Samurskoe and the camp. They were, moreover, held in readiness at night to reinforce the trench guards in case of need.

From December 24th, for several days, the Tekkés showed themselves scarcely at all outside the wall of their citadel, and from time to time only they signalized works completed by them in the ditch and upon the traverses situated opposite openings leading into the south and east fronts of the citadel.

On December 24th a service of scouts was organized in the "Right Flank" kala, for the purpose of reporting movements of the Tekkés, by day or night, in the direction of the desert and Askhabad.

From the same date, columns charged with collecting forage were sent out every day toward the east of the oasis. They were protected by infantry and artillery. From the talk of the Tekkés later, it was learned that these minor operations, which procured important resources for the Russians and occasioned no loss, struck very strongly the imagination of their adversaries, who judged that the Russians felt themselves very strong to send troops over the Askhabad road and detach escorts for their con-

voys, at the same time that they proceeded to the siege of the citadel.

As the enemy remained shut up in the citadel and did not show himself, the order was given to fire from time to time salvos of indirect fire, with sights varying from 600 to 300 paces.

During this time the Tekkés continued to fortify themselves opposite the left flank, between the "Grand Duke" Creek and the *enceinte*.

Nevertheless, they did not trouble the siege works, and Skobelev resolved to carry by main force the position of the "Grand Duke" kala, on December 29th, after having prepared for the assault by a bombardment, and then to occupy the following day the "Petrusevitch" garden, which would prevent the Tekkés from communicating freely between the citadel and the desert in a north-easterly direction, or compel them at least to make detours.

#### SORTIE, DECEMBER 28TH.

On December 28th, a grand council was held in the citadel. The chief, Tökme Sirdar, promised to annihilate the Russian troops by a night attack, which he volunteered to direct himself. This proposition was accepted; 4000 volunteers presented themselves to take part in the sortie. Among them were a large number of Mervians and some women.

At nightfall, Tökme Sirdar threw himself with impetuosity, without firing a shot, upon the right flank of the siege works, out-flanking them.

At the moment of attack, the trench guards were awaiting their relief and were ready to return to camp. The commandants of the right and left flanks, the chief of staff, the commandants of artillery and engineers, were all in General Skobelev's tent, considering with him the works to be executed the following day. Hearing the cries of the Tekkés and the fire of the artillery, all hastened to their posts. Skobelev took with him two companies of the reserve charged with guarding the camp, but fearing further attacks upon other points and upon the camp, he did not proceed immediately to the front.

Three companies which were to furnish during the night laborers on the left flank were marching to their posts; at the noise of the fusillade the officer in command did not hesitate to take them to the right flank.

The Tekkés rushed simultaneously upon mortar battery No.

5 and upon Redoubt No. 2. The cannoneers had only time to seize their revolvers, their only side arms. The piece placed in Redoubt No. 2 could fire but a single shot of canister. A hand-to-hand-conflict ensued. The Tekkés drove the Russians from Redoubt No. 2, and from batteries 5 and 6, and occupied the space between the 1st and 2d parallels; they then threw themselves on batteries 3 and 1, while other masses marched upon Redoubt No 1, and overrunning through the interval which separated it from the "Olga" kala, thus turned all the siege works of the Russians and had their way open to march upon the camp. In a few minutes 3 mortars and 5 guns fell into the hands of the Tekkés, with the flag of the 4th battalion of the Aspheron regiment.

Thanks to the bravery of the artillerymen of Battery No. 1, who, turning their guns in all directions, opened fire with canister upon the Tekkés, and thanks to the coolness of the infantry occupying Redoubt No. 1, these two works remained in the hands of the Russians. But new masses of the enemy approached and the situation of Redoubt No 1 became critical. Happily, some companies of reinforcements arrived from the camp and stopped by volleys the movements of the Tekkés; the pieces which had fallen into their hands were recaptured, with the exception of a mountain gun which had already been taken into the citadel.

The works occupied by the Tekkés were retaken by main force and the enemy retired into his fortress.

At the same time that they attacked the right flank of the siege works the Tekkés attempted a surprise against the "Right Flank" kala, defended by a company of infantry, a detachment of Cossacks, 4 guns and two machine guns from the marine. Four times they rushed to the assault: the defenders allowed them to approach within a very short distance, then fired volleys which threw the Tekkés back. After the fourth attempt they retired into the citadel.

During this sortie, the Russians lost 5 officers and 91 men killed, 1 officer and 30 men wounded. Besides, one flag, a mountain gun, and two caissons of ammunition remained in the hands of the Tekkés.

The latter cut off the heads of the greater number of the dead and placed them on sticks which they planted before their tents. The account does not so state, but there is no doubt that the *wounded* were, so far as possible, decapitated also, in accordance with the usual custom of Turkomania.

Very few of the Tekkés arrived with fire-arms, most of them carrying sabres, many only daggers and butcher-knives tied to long sticks.

On the Russian dead and wounded were found almost exclusively the marks of "cold steel."

The relative success of the Tekkés is to be attributed to the rapidity of the attack, which was so much the more unexpected as the preceding nights had been tranquil.

The length of the trench was too great for effective guarding by those charged with the defense. Finally, the works were not entirely finished; the redoubts had only a very weak profile, so that the Tekkés experienced no difficulty in escalading Redoubt No. 2.

A Russian soldier afterward described the surprise to Verestchagin as follows:

"It was so dark that you couldn't see your hand before you, but you could hear something flowing up like a wave and surging, but you couldn't see to fire. Then they gave a yell at us, and the affair began."

Immediately after the fight was ended, a new detachment of workmen was ordered out. Skobelev attached great importance, from consideration of the moral effect principally, that all the works which he had ordered constructed in advance of the 2d parallel should be finished by morning.

Measures were taken to protect the workmen in case of a fresh attack by the Tekkés, but the latter remained quiet.

The affair of December 28th was the most successful operation of the Tekkés during the entire campaign. Their losses, from their own account, were insignificant. Their morale was exalted, and the defenders of "Géok Tépé" no longer doubted the impossibility of the Russians capturing their citadel. They estimated that they had destroyed *one-half* of the operating detachment. From the next day, the captured gun was placed in battery against the Russians, but the results of their fire amounted to but little, the Tekkés not having discovered how to burst the shells captured with the gun.

As soon as possible after the sortie, the camp was brought up nearer to the siege works, where it was in the zone reached by the musketry fire of the Tekkés, and almost every day men and horses were hit.

From December 23d Skobelev had manifested the intention of bringing the camp near the siege works, but had given it up.

1st. For the security of the troops, and that, in consequence, their rest might be more complete. 2d. To save the troops the labor attending the transfer. 3d. To avoid an attack on the rear of camp, from the side of Yanghi kala, which could not remain occupied. To remove the grievous impression produced upon the Russian troops by the sortie, Kuropatkine was ordered to carry by main force, the next day, the group of kalas forming the position called that of the "Grand Duke."

This group was composed of three kalas; the principal situated on the stream "Grand Duke," was distant 700 feet from the fortress wall; the two others, called "Volunteer" and "Turkestan" kalas, were upon the left bank of the same stream, the former being only 350 feet from the *enceinte*. The surrounding ground was cut by a number of clay walls from two to four feet in height.

The occupation of this position would give to the Russians very advantageous cover, the adversary possessing no artillery.

Skobelev attached the greatest importance to the success of this operation, as is shown by the following extract written in French in a letter addressed to Kuropatkine:

"I pray you, dear Colonel, to only take into consideration, hereafter, that it is no longer a question of more or less considerable losses, but indeed of *victory*. Raise the morale of the troops, cost what it may; you know me well enough not to doubt that having burned our vessels, I am equal to passing the Rubicon with the last of our soldiers.

"I hear a lot of rumors spoken of. Make everybody keep quiet. I will have one of the blabbers shot, if necessary, whatever his rank. The greatest battles have been lost from having permitted prating in the ranks.

"I rely upon your energy and your devotion to the flag."

At 2 P. M., on the 29th, the artillery commenced the bombardment of the position for attack. At 3 o'clock the breaches were practicable. Kuropatkine formed his troops in three columns, the third forming the immediate reserve for the others, and one sotnia of dismounted Cossacks was kept as a general reserve.

The first column was to capture the "Grand Duke" kala, and if it succeeded without too sensible losses, would then direct itself against the two other kalas. The second column was to immediately follow the first.

Kuropatkine having called together the chiefs of the columns

and the company commanders of the first column, pointed out to them in the most precise way the objective of each company. The captains then informed the officers and men of the end to be attained by each unit.

At 3 o'clock the movement commenced.

A desperate struggle followed the attack on this position, and, moreover, the Russians feared every instant a sortie *en masse*. Skobelev was observing the action from Redoubt No. 1, and sent two companies from the camp as reinforcements for Kuropatkine.

At 5 o'clock the latter reported that he was master of the three kalas, but that the Tekkés occupying the gardens behind them, and the rampart, as well as the traverses placed before the openings leading into the *enceinte*, were directing upon him a very intense fire. He requested cartridges and two mountain guns, which were sent to him.

At 6 o'clock the combat ceased. Ten companies of infantry occupied the position that night supported by two machine and two mountain guns. The three kalas were immediately organized to facilitate their defense, connected with each other by trenches during the night, and a communication opened with the second parallel.

The Russians expected a sortie every instant, but the Tekkés, struck, doubtless, by the bold, unhesitating counterstroke of the Russians, and their nearness to the citadel, contented themselves with keeping up a light fusilade, and also constructed bonnets upon the parapet to aid in firing upon the Russians behind their works.

The success of the besiegers on the 29th raised the morale greatly, effacing the unfortunate impression caused by the action of the preceding night.

On December 31st, the Russians organized in the "Right Flank" and "Volunteer" kalas posts of observation, with the object of making a plan of the interior of the fortress, estimating the force of the garrison by the number of tents, of observing all the movements of the men, camels, and horses which took place in the interior, to observe the points of fall and effect of projectiles, and to give advice of the assembling of troops and sorties.

These posts furnished frequently very detailed information of great importance. On the very day of their establishment the tower at the "Volunteer" kala advised that the Tekkés were preparing to make a night sortie, and for that end were massing in the ditches of the citadel.

To prepare for any event, Skobelev brought up near Redoubt No. 1 a reserve made up of troops of all arms, and Cossack patrols were sent to explore the ground situated between Redoubt No. 1, the position of the "Grand Duke," and the stream of Op-ernöe.

The success of the sortie of December 28th, had determined the Tekkés to attempt a new attack. Six thousand volunteers presented themselves to take part, and in the number were a great many women carrying sacks to collect the expected booty.

Tökme Sirdar, having ascertained from a reconnaissance that the rear of the Russian post was fortified, determined to make a demonstration only in that direction and to strike the principal blow on the left flank.

To this end, the sortie detachment massed in the place of arms near the "Mill" kala.

At 9.30 P. M., having fired a few isolated shots (doubtless as signals), followed by two salvos, the Tekkés threw themselves upon the left flank of the works which they outflanked, while masses followed themselves simultaneously before the "Turk-estan," "Cavalry," and "Right Flank" kalas, as well as upon the left flank and rear of the Russian camp.

The artillery opened fire against the citadel and against the assailants. Some projectiles fell in the midst of the Russian troops and produced great confusion, the almost inevitable result of a desperate night combat.

At the first discharges, Skobelev marched from the camp on Redoubt No. 3, where the fight was hottest, with two companies of infantry, who were promptly reinforced by a third, a platoon of artillery, and a half sotnia. The approach of these troops determined the Tekkés to return into their citadel. Their principal effort had been directed against Redoubt No. 3, situated on the extreme left flank, and on the rear of the 1st parallel. They secured possession for a time of the *redoubt* after a hard struggle, and carried off one of the mountain guns. The reinforcements then recaptured it, and saved the remaining gun.

After the retreat of the Tekkés, all the Russian artillery commenced to fire into the interior of the fortress and the bombardment lasted until morning. The infantry executed indirect salvos. From the great noise made by the sheep and camels, the Russians believed for a time that the Tekkés were preparing to abandon the fortress, but this proved a false alarm. The siege

works were pushed with activity, and in the morning the Tekkés were compelled to abandon the trench in advance of the south front.

The loss of the Russians in this sortie was : 1 officer and 52 men killed, 2 officers and 98 men wounded.

The Tekkés had carried off one mountain gun, some hundred Berdan rifles and an immense number of cartridges.

As before, the losses had been inflicted with "cold steel," and so far as possible the Russians had been decapitated.

The following shows of what stern stuff the Russian soldier is made,

A chief canonneer had been captured during the second sortie. The following day, the Tekkés tried to force him to fire upon the Russians with the captured mountain guns. Upon his refusal, they cut off his fingers, then his ears, then they flayed his back. The man persisted in his refusal, and then they cut his throat and decapitated him. The name of this brave soldier was Agathon Nikitine.

It is to be hoped that somewhere in Russia where soldiers congregate, the memory of this man of iron nerve may have been perpetuated by a monument, with inscription to indicate how he suffered martyrdom for his comrades and his flag.

The Tekkés claimed to have suffered but little, and commenced to gain hope that their enemies would be forced to raise the siege. Great was their surprise on the following day when they saw the Russian camp moved up close to the 1st parallel.

This move was considered indispensable, in view of the offensive spirit of the Tekkés and their unexpected attacks.

It was necessary that the reserves should be equally ready to act in the case of attempts against the siege works or against the camp.

The front and flanks were now covered by the first parallel ; but the men and horses were entirely in the zone of infantry fire from the walls. The tents were, in consequence, ordered sunk to a certain depth and a parapet was to be made about each, but with all the other work on hand, this was never thoroughly done throughout the siege.

The size of the camp was reduced as much as possible, and in this crowded condition it afforded an excellent target for the Tekkés, and every day men and principally horses were killed or wounded.

All the efforts were now to be concentrated on the right flank. The front of attack would be formed by the "Grand Duke" position, the embankment on the left bank of the stream of the same name, and the stream itself. The parallels became then simple communications. They were to continue from this side to approach the *enceinte* and to commence the works for the mine intended to form a breach. The chief of engineers was charged with determining the point of attack. Independently of this, a second breach was to be made by the artillery towards the south-east angle of the fortress. The chief of artillery was charged to study with care the south face of the *enceinte* and the means of making a breach near the angle.

There were at this time (January 1st) many serious defects in the Russian siege works, due to the haste with which they had been constructed. As a whole, they did not form a solid position, well covered on the flanks; the trenches, narrow and deep, lacked outlets toward the rear; there was no "place of arms" for the reserves; the artillery had not been assigned with method; finally, the organization of the camp left much to be desired.

All these defects were pointed out to Skobelev in a conference, but it would have taken a week to remedy them. Then Skobelev from experience feared the effect of the grossly exaggerated accounts which he knew would be circulated throughout Central Asia concerning the success of the Tekkés in the two sorties so far made. He knew that among the natives the energetic movements in advance by the Russians after each sortie, and the fact that the initiative had remained in their hands, would be lost sight of in view of the capture of a flag and two guns and other material evidence of relative success on the part of the Tekkés. He feared that his lines of communication would be broken and his posts attacked. Besides, each day occasioned new losses and the task of the survivors increased in proportion. A delay would not have improved the morale of his troops, already affected somewhat by the sorties described. For these reasons, Skobelev resolved to continue energetically the advance.

The important point of the Russian front was now the position of the "Grand Duke." This was called the *centre* of the siege works and placed in charge of Kuropatkine, Skobelev's "right-hand man."\*

\* "Kuropatkine possesses all the characteristics of Skobelev, cast in a cooler mould. They worked admirably together, Kuropatkine imparted coolness and cal-

From the 1st to the 3d of January the siege works were continued. A place of arms was established behind the "Grand Duke" kala, and the ground in front cleared to facilitate the fire. Near the front face of the *Volunteer* kala a mine well was started, but water interfered and this was abandoned. Other works were also constructed on the right flank.

To be able to commence the mine at a short distance from the citadel, it was decided to occupy the embankment of the stream "Grand Duke," and seize a cattle inclosure near the ditch of the fort. The latter was about 84 feet square, surrounded by a low clay wall, and distant from the *enceinte* about 60\* yards. These points were seized and fortified on the night of the 3d. By making use of gabions and empty artillery chests, at daybreak the cattle inclosure was well prepared for defense, and was connected with the "Volunteer" kala by a covered communication.

On the evening of the 4th, the lookout in the Volunteer kala signalled that preparations were being made for a night sortie. Every possible preparation was made, and now the troops were placed, not in the trenches, but behind them. In the presence of such an intrepid adversary, the trenches lost the importance which they possess in a struggle between European armies. During the day, they served as covered communications and rendered excellent service, but at night they constituted rather a danger for the troops charged with defending them.

The Tekkés crept, without firing a shot, to within a short distance, then leaped upon the parapet, and the Russians standing below on the banquette were at a great disadvantage. A few sentinels and the best shots alone remained posted behind the parapet.

The Tekkés had for this sortie 12,000 volunteers, and they staked all their hopes on its success. At 7 o'clock, favored by thick darkness which prevailed between the setting of the sun and rising of the moon, they made an impetuous attack upon the left flank and upon the works in front of the "Grand Duke" position.

The attack was so sudden that a post of ten Russian soldiers placed at 80 paces in advance of the embankment did not have

ulation to Skobelev, and Skobelev fire and enthusiasm to Kuropatkine."

"I am quite desolate now that Skobelev is gone, but it is a consolation to all of us that we have still got Kuropatkine. He is now the Skobelev of Russia." Turk-estan Officer, Marvin, pa. 5.

\* 25 sagues=58 $\frac{1}{8}$  yds.

time to fire a shot. Three were killed, three others wounded; four succeeded in regaining their company.

The combat lasted but a quarter of an hour, and the Tekkés were repulsed with great slaughter. Their loss was so considerable that there were but few tents in the citadel which had not some killed to mourn. The Mervians, who had lost about 200 men in this sortie, nearly all left for their oasis the following day.

In conformity with his custom, Skobelev hastened as soon as tranquility was restored, to send the order to the commandants of the centre and of the left flank of the siege works, to finish during the night, cost what it would, the works which had been indicated before as to be executed. This was effectually done.

Besides other works in progress, from the trench connecting the embankment with the cattle park two heads of sap were run about 50 feet apart; these were pushed forward 56 feet and then joined by a perpendicular trench. The saps were then continued from the extremities of this trench, to be prepared to force a passage of the ditch if the mine should fail.

Midway in the connecting trench a well was dug, and a gallery directed towards the citadel wall. This was pushed forward with all possible haste. The earth was firm and no revetment was necessary for the gallery, and fortunately the ditch was dry in its vicinity. The Tekkés realized what was in progress, but were puzzled as to its real object. Some of the knowing ones assured them that the Russians were simply tunnelling to reach and enter the interior. They were rather pleased than otherwise at this prospect, and waited patiently for the appearance of the burrowers.

A battery of ten mortars was established in front of the "Volunteer" kala and armed during the night of the 6th and 7th. This battery was to prepare the assault, enable the bombardment by a vertical fire of all the terre-plein of the citadel, prevent the enemy establishing himself securely upon this breach in case of a failure in the first assault, and finally, to sustain the morale of the troops. The effect of the fire of this battery was quickly shown; the Tekkés moved their tents towards the wall where they would be less exposed.

The tents had been sunken and protected more or less from direct fire, but the mortar shells found them out and, bursting inside, would at times destroy all the occupants.

On the 6th Skobelev proposed, through the lookout on the

"Volunteer" kala, a truce to the Tekkés to permit them to carry away their dead. The walls were soon covered with curious Tekkés, but no satisfactory arrangements could be made, and finally the Tekkés warned the Russians to conceal themselves as they were to recommence firing. When the Russians were protected and the Tekkés had disappeared, Skobelev with exceeding politeness proposed to the Tekkés to fire first and then after an hour's rest, the action reopened.

On January 8th, at 8 A. M., the breaching battery established towards the left flank opened fire with 8 4-pdrs. Its fire was very efficacious, and at the end of two hours a large cut of 70 feet was opened in the wall, and inside could be seen the upper parts of the tents opposite the openings. The enemy tried to repair the breach, and volunteers, moving out to make it practicable with dynamite, found the ditch full of Tekkés and retired.

The Russians then increased the breaching pieces to 12, and constructed four trenches behind the 3d parallel in order to mass there an assaulting column.

In spite of shrapnel and musketry fire directed during the night upon the artillery breach, the Tekkés so repaired it that on the morning of the 9th the height of the rampart was uniform, and the tops of the tents no longer visible.

As it was now evident that the mine would not be in readiness until the morning of the 12th, Skobelev decided not to reopen the artillery breach until a little before the assault.

Although the Tekkés had still the energy necessary to oppose a desperate resistance, yet their offensive spirit was broken, and from the opening of the breach they awaited the assault from hour to hour.

From all he could learn, Skobelev felt sure that their morale was weakening, and he had confidence in the success of the assault.

On the 11th, it was announced that the mine was about in readiness, and all preparations were made for assault on the 12th. The mine was charged with about 2800 lbs. of powder.

Three columns of assault were to be formed :

The 1st, under Kuropatkine, was to storm the breach made by the explosion of the mine.

The 2d to attack the artillery breach, and the 3d was to create a diversion by attacking at 7 A. M. the "Water Mill" village, about 450 yards from the western face.

At the same hour all the artillery would open fire. Skobelev was to occupy the 2d parallel and the "Stavropol Redoubt" (No. 3), and be ready to act as circumstances required.

The assault of the breaches was to be preceded by a violent bombardment lasting half an hour.

The men were to carry biscuit for two days, sugar and tea, cooking pans, gourds, 120 cartridges per man, and portable tools.

Details were made to guard the camp and works.

The rôle of the artillery was, in a general way, as follows:

At daybreak they were to make practicable, if deemed necessary, a breach to the east of the one already made in the rampart of the south face. 22 pieces were designated for this and 1000 shots allowed as sufficient. Meanwhile, all the other pieces would direct their fire upon objectives already selected. The points of fall and effect produced were to be signalled from the post of observation at the "Volunteer" kala.

A half hour before the assault, all the artillery would execute a violent bombardment against the south part of the citadel. One or two salvos of all the pieces would be directed upon the same immediately after the explosion of the mine.

At the moment of assault, the pieces would increase their range and take for their objective the north and northwest of the fortress. The men in the assaulting columns were forewarned that the artillery would fire over their heads.

If the mine proved unsuccessful, pieces were to be taken immediately to the emplacement of Battery No. 5, and an artillery breach made in the east face.

Mass for the success of the operation was celebrated at two o'clock the preceding afternoon in the presence of all the troops not on duty.

#### ASSAULT.

At 7 A. M. on the 12th, the 12 guns in the breaching battery opened fire on the old breach made on the 8th, and afterward repaired by the defenders; 18 other guns aided in this work. In a little time, in spite of all the efforts of the Tekkés to repair the gaps, the breach was made practicable, and the guns commenced firing shrapnel upon the workmen attempting to carry the earth for repairs, but could not make them abandon this enterprise.

Orders were given to fire the mine at 11.20.

At the appointed time, "the earth trembled, a terrible roar resounded, and a huge black pillar of sand and smoke rose heaven-

ward." When the air cleared, a practicable breach 140 feet in length appeared in the parapet.

The effect produced by the explosion was entirely unexpected by the Tekkés, and terrified them so that all, as they acknowledged later, lost their heads for a time, not comprehending what was taking place. A great many believed it to be an earthquake. Some of the weaker spirits took to flight, but the greater number of these courageous men decided to die rather than desert their fortress.

Before the smoke of the explosion had entirely cleared away, Kuropatkine's advance column was in the breach, closely supported by a second and third. The Tekkés quickly recovered their coolness, and a desperate struggle ensued, but the Russians after considerable loss forced them back foot by foot, and it was finally necessary to pursue them into the tents and huts in the ground, where isolated men continued to defend themselves with a furious energy. No quarter was asked, none given. It was one of those hours of hell upon earth which, doubtless, will always be seen when an infuriated soldiery finally succeeds in breaking the resistance of a barbarous and merciless foe.

There was now seen a tendency on the part of the mass of the defenders to retire to a large mound near the centre of the fortress, and the signal station announced the departure into the desert of a part of the defenders by the exits of the north front.

To hasten the end, Kuropatkine put all his troops in march towards the mound, to the sound of music and roll of drums, standards displayed. At all points the resistance of the enemy was broken. At one o'clock the flag of a Russian battalion floated on the mound.

The Kozelkov column met with serious resistance at the artillery breach, but Skobelev had sent up a reinforcing battalion, and after a bloody *mêlée* this breach was occupied. A half company of this column arrived in time to take part in the assault on the mound.

The purpose of the Gaidarov column on the left was to create a diversion. This had started out early in the morning, attacked the "Mill" *kala* with artillery, and then carried it without meeting great resistance.

They held this defensively until the assaults, opening fire by volleys on the fortress and then on the mass of Tekkés in the ditch when they began to desert their stronghold.

Then the third column rushed forward, scaled the wall with ladders, and took part in the grand *mêlée* within.

Verastchagin, who was with this column, describes his first impression of the interior :

"It is black with a multitude of smoke-stained felt kibitkas placed close together. Look where you will, the corpses of men, horses, camels, asses, dogs, and cows lie strewn about. Throngs of women, wrapped in black veils, are flying in terror from one kibitka to another, dragging their helpless children behind them. Our soldiers are pursuing the foe on every side. The groans of the enemy, the whimpering and shrieks of the women, the wailing of the children, the roar of animals, shouts of 'Hurrah,' 'Allah,' the thunder of cannon, have all mingled in one indistinct, horrible roar. It seemed to me that I was looking upon a picture of the Last Judgment. Only the Imperial standard, floating from the top of the mound, reminded me of the true state of the case."

At 2 P. M. Skobelev, seeing himself undisputed master of the fortress, placed himself at the head of two squadrons of cavalry and a sotnia of cossacks and started in pursuit of the enemy, who were fleeing into the desert in two large masses.

A detachment of infantry supported the cavalry.

The horsemen stab, and hew and shoot. No mercy is shown to any one. Hundreds of corpses sharply indicate the roads followed by the fugitives across the sandy yellow plain. The cavalry pursue for ten miles and are then ordered back. Night was approaching, and the fugitives had scattered.

The loss of the Tekkés on that day is estimated at from 6000 to 8000 men. Their total loss during the siege was estimated by Skobelev at 20,000. In other words, half the defenders perished. It left an ineffaceable mark on the memory of the Tekkés.

The fortress was given up to pillage for four days. The booty abandoned to the troops was estimated in value at 6 million roubles. The women and children remaining in the *enceinte* to the number of about 5000, were collected together and protected.

This was the end of active operations. There remained only the necessary steps for the pacification of the oasis, and the determination of boundaries.

This expedition cost the Russians 1000 men killed or wounded. That was owing not only to the bravery displayed by

the Tekkés, but also to the fact that they possessed 600 rapid firing rifles which they knew how to use.\*

The old chief Tökme Sirdar, is now a major in the Turkestan militia. There are 2000 of these Turkoman soldiers, and their only dream is to show the Russian Czar what they can do. There is every reason to trust to their loyalty.†

Every vacancy that occurs in this militia has a hundred applicants from among the Tekké warriors. In the next great European war in which Russia takes part, will, doubtless, be seen a representation from this Turkoman cavalry.

The verdict of the Tekkés was: "Who can resist such men? God willed it. The white Czar is our sultan."

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\*" Kuropatkine," *Revue Militaire*, No. 626, p. 64.

† *Harper's Magazine*, Jan. 1890, p. 202. Article by Russian General officer.

## RECRUITING EXPERIENCES.

BY LIEUT. HARRY L. HAWTHORNE, 4TH U. S. ARTILLERY.

A SHORT description of the troubles of a recruiting officer may suggest to our reformers a wholesome direction for their work ; but, failing this, it may set vibrating a sympathetic chord in the bosoms of some of my military associates who may perhaps recall their experiences as a mingling of the irritating and the grotesque, and whose mileage rewards far from compensated for the mental and moral exhaustion, and the work of correspondence with nearly every military department of the Government when the "fitful fever" had passed away.

It was the fate of the writer to be among the first to enter on the trial of a new method of recruiting, evolved under the supposed need for a better class of enlisted men.

A voluminous order is placed in your hands telling you, among other things, to begin correspondence with the various departments of the army with a view to the collection of books, stationery, blank forms, posters, permission to advertise, funds for several distinct and absolutely unmixable purposes, transportation vouchers of several species, corresponding to the kinds and cost of the railways over which it is necessary to pass, several varieties of certificates of soul-compromising qualities, and a blank telegram book with a sort of "sign-your-name-and-we-do-the-rest" air, but which will soon rouse all the demoniacal instincts of the gentlest of natures.

This order hints at a certain outfit necessary to the successful prosecution of the search for recruits ; such as a measuring machine, a weighing machine, a sight testing machine and a manual from which to learn the art of surgery in from three to five days. The obtainment of these, however, is left to your enthusiasm, your pocket money, or the generosity of your friends.

But all things must have an end, so at length your trunk, with fifty to sixty pounds of blank forms, is packed, and the departure of the "recruiting party" awaited, in order that, by leaving the day after, the government may be hoodwinked into the belief that the travel is "without troops." This interim in your troubles

is but short-lived. By the aid of the post quartermaster, the transportation intricacies unwind themselves quite simply, but this security is a delusion and a snare. On joining the "party," you find that the members have been selected by their captains; good assistants, perhaps, but not scholars, no, nor clerks, nor men whose handwriting is even legible. The awful truth becomes plain that if your salary has never before been earned by the pen, it will have to be now. Your only mental nourishment is Tripler's Manual and the Army Regulations. The examinations take place with one eye on the picture of the *décollété*, but carefully diseased man in the manual, and the other on the shivering applicant.

The procession of recruits moves on, but the frequency of human imperfections makes you rejoice that our race wears clothes. At length a small squad of Apollos is made up, sent under charge of a member of the party to the depot. How simple that sounds. In this case words are used to conceal a mental and moral trap. The papers necessary to carry out this small military movement comprise,—an order, by yourself as commander of the rendezvous, on yourself, as quartermaster and commissary for transportation and subsistence. As quartermaster you endorse on this order the proper execution of it and then proceed to the composition of the transportation vouchers.

This involves a study of the road, its history, dealings with the Government in the dim past, whether it sold itself body and soul, wholly or in part, and, if the latter, how much, where, and under what circumstances and conditions. In this way the kind of voucher is decided upon and is made out in accordance with what you conceive to be the requirements of the law. It may be months before you see this voucher again; nay, it may be years; but you will see it again. It comes back loaded with questions from people with whom you have never had dealings before, and who, apparently in pure friendliness, call your attention to certain general orders issued before you entered the army. Maybe you can explain, but the chances are that you cannot. In any case you endorse and the papers sail away once more. A clerk, in an auditor's office, in a printed letter, tells you, in after years, something about their "having been found correct"; but you have forgotten all about them; and the only sensation which they arouse is a general feeling of thankfulness towards the whole world.

As commissary, certain dealings are entered into with the landlady (this is the usual head of the men's boarding house in small towns) for the food to be carried or commuted. She is usually ignorant and fussy and when she signs the receipts and other papers, regards the whole transaction with plainly expressed suspicion, as it has all the indications of an underhand attempt to get a mortgage on her house. Having thus obtained several illegible signatures and a number of greasy finger-marks on the vouchers, the next attack is made on the telegraph office.

Here is spent about half an hour writing a history of your official intentions towards all parties concerned, including the Quartermaster General, the Chief Quartermaster of the Department and the Railroad Co., telling by what right the telegram is sent, by whom settled and under what appropriations, and finally swearing hard to the truthfulness of everything you have said—all for five or six words of one syllable each. The agent receives the sheet of light blue paper, looks it all over, looks all over you, then proceeds to examine it with a microscope. At the end of five to ten minutes he begins an extensive consultation with all the clerks in the place, including the typewritist. Finally he returns to the desk, looks you all over again and then asks if you want to pay for it. Receiving a reply in the negative he asks if you want to send it "collect." On again giving a negative answer, everybody looks up and pitying smiles are exchanged. The agent explains, in a cold voice, that it must be sent one way or the other, and shows by his own regulations that he cannot treat government telegrams differently from others except to charge more. The conclusion is then plain that the Government has made a compact with the telegraph company without requiring that the company's rules conform to it. This telegram book will prove a source of endless woe and perturbation of spirit. To escape it, sink the book to the bottom of your trunk, write short telegrams, and pay for them from your private purse.

The end of each month brings a terrible struggle with every known variety of blank forms, which are in duplicate except those which are in triplicate. In the several pockets of your vest are kept the different funds belonging to distinct appropriations, requiring complete sets of vouchers and reports to each department head. Each is audited in turn, only to find an incorrect cash balance. By combining the whole and going down into the

pocket containing the remnants of the previous month's pay, this trouble can be cleared away.

About a week after, while refreshing the memory of your duties with the great General Order, a paralysis of fear comes on, caused by the discovery that three or four very necessary reports have been overlooked.

As time goes on, correspondents thicken. The examining Surgeon at the Depot is heard from; the Superintendent writes a friendly warning; savage mutterings are heard from the captains where the recruits have been distributed; and finally, to crown this misery, an infuriated father, heading a tear-stained mother, drops in to tell the recruiting officer what he thinks of him for enticing away his son who is only 20 years 11 months old, but who swore that his age was 21 years 1 month, that both his parents were dead, and that he was a stranger in a strange land.

The days which immediately follow the return are perhaps the saddest of this period of your life. Up to this time the members of the "party" have stood loyally by their leader, and in return he has rented for them feather beds, palatial boarding-houses and first-class cars. They now turn and enter complaints and claims which make them appear very much like the Christian martyrs. It seems that they had to pay for their baggage, for meals during an unexpected delay over a carefully calculated route, for stoppages made necessary by taking the wrong train, and other sources of trouble for which human ingenuity could not provide.

These troubles only outline the sum total of the unpleasantness of this duty. With a permanent rendezvous the worst features of the system disappear. Why cannot the clerical duties be simplified? Reduce the several funds to one; the army of officers to whom responsible, to one; the kinds of vouchers for railway transportation, to one; or, better still, use money only, with simple certificates for bond-aided roads. Use money in all transactions as quartermaster and commissary, presenting simple receipts as vouchers to an account current. One oath to cover all of an officer's transactions, instead of a continuous stream of certificates each time the name is signed.

The present system is cumbersome, unnecessarily intricate and voluminous. This is a fair direction for reform in our regulations and methods and should demand attention with other modern-day innovations.

## OUR NEW DRILL REGULATIONS FOR THE INFANTRY.

BY LIEUT. C. J. CRANE, ADJUTANT 24TH U. S. INFANTRY.

NAPOLÉON has been credited with saying that a nation should change its drill tactics every ten years. Since 1870 the Germans have changed theirs five times, and the other great powers of Europe have changed theirs more than once. Ours were last changed—until very recently—in 1873, and that fact is a monument to the far-seeing energy of General Upton in giving us a system which has so long held its own in spite of European wars and their teachings based on the use of more improved weapons of war. Since the days when Tilly and Wallenstein fought their dense brigades, almost solid squares, the tendency has steadily been to reduce the depth of the fighting formation of the infantry, and many hoped that the new drill regulations would continue the practice and give us a single-rank formation, something essentially American and well thought of by more than one leader of opinion on the other side, as well as being peculiarly adapted to our national characteristics.

I believe that the single rank formation will come, though it is possible that we may have to wait till the Germans have adopted it.

### SCHOOL OF THE SOLDIER.

All movements and explanations in this school are most important, the kind of soldier and his efficiency under all circumstances depending so much on how he is taught the rudiments, and what rudiments are taught him.

We now have seventeen (17) exercises, a number of them being modifications of the old ones under new names. It is not believed that so many are necessary in setting up a soldier. Those practised so long are enough, when properly taught, to make a man straight and muscular and to keep him so. The exercises as given in the text are confusing to the instructor and to the soldier, and would be more easily taught and learned if divided so that not all are called exercises; for instance, let the old

double step and balance step remain so, there being something suggestive in their names.

Most of the movements and explanations in the School of the Soldier are based upon our old authority, Upton, and with some exceptions, the changes, when well known and familiar to us, will be liked, for as a rule they are practical.

The interval of six inches is not understood. At first I believed the reason for it to be that both ranks might be able to fire lying down in double rank, but in paragraph 85 we are told that "when lying down in double rank, the rear rank men do not aim nor fire." I can see no advantage in the loss of elbow touch, and believe it to be rather a disadvantage, tending to carry with it a loss of precision and accuracy on the drill ground.

It will be a long time before "Dismissed" will sound as well or as military as "Break ranks. March."

Is it not an advantage to have a halt that can and will be executed as given in the text? To see a body of men halt well together is a better proof of good drill than to see the same men move off well together. For ten years I have watched carefully to see the halt executed exactly as explained in Upton's Tactics, which say that the command "Halt" should be given "the instant either foot is brought to the ground," and the halt completed without the addition of another step. The result of the attention bestowed on this subject is that I have seen another step taken after the command "Halt" by all the militia and regulars that I have observed, and by the U. S. Corps of Cadets, except one company, which at the time was giving special attention to that particular point.

It is perfectly natural to take another step after hearing the command "Halt," and it *will* be done under the wording of the new drill regulations just the same as when we tried to carry out Upton's ideas; the difference in time between "as either foot is coming to the ground" and "the instant either foot is brought to the ground" is too short to make any difference with the men who are trying to obey the command.

In dropping the old wheels for the present turn, the new book stops too soon; the turn should be the same as the one we have practised so long. It is more quickly done and would be as well done drill as the one executed in quick time. In the manual of arms the new regulations have prescribed the "body rest" as the position to be taken in aiming and firing. It is difficult to understand what

reasons could have caused the change from the old time off-hand position. It is true that a great many good shots in the army use the body rest in firing at the target, but they are in the minority, and it is generally understood and it is taught in the Firing Regulations for Small Arms, that it is good only when there is no strong wind, and in firing at motionless targets. All the pointing and aiming exercises in the Firing Regulations are explained for the old off-hand position. Captain Blunt is right in saying of the body rest, that "when it can be easily taken it generally enables the soldier, firing in calm weather, to hold the rifle for a longer period upon the mark, and in that respect possesses a great advantage. In a side wind or in taking aim very quickly, or at moving objects, its adoption probably results in a slight loss of control over the piece." He seems to favor for "firing in strong wind or at moving objects," also "when a rapid as well as accurate delivery of fire is desired," extending the left arm nearly to its full length.

As between the body rest and the off-hand positions, it seems to become a question as to what kind of a target we are to call an armed enemy using his best endeavor to kill us, then, naturally, what position in firing should we take to defeat his purpose. Is a hostile soldier a motionless and harmless target who will allow us all the time we want for firing with that position which requires the most time for aiming, or is he more like the wildest, most desperate and dangerous game a man ever hunted, requiring the quickest sort of aim under all conditions?

I have taken great interest in target-practice and have seen the body-rest taken by some of the best shots in the army when firing at the target, but I have never yet heard of a man who used that position in firing at game.

In using the rapid fire, men will take that position most natural to them—which is not the body-rest—and it would increase their efficiency if the position taught them should be at the same time the most natural one.

A number of useless movements have been omitted in the new text-book, and the movements relative to fixing and unfixing bayonets and the load, are executed without the numbers.

The general rules given in paragraphs 112 and 113 contain a good description of the spirit of the changes made. In taking intervals to the right or left, as described in paragraph 153, each man has to look behind and take his interval from the man in

rear, which works awkwardly with more than a small squad. The command "Halt" would improve the movement.

The position of the legs in kneeling, being nearly at right angles, is still constrained; few men with average angle between the feet when standing naturally, will, from preference, take the kneeling position prescribed. A better position would be obtained by carrying the right foot nearly straight to the rear after half facing to the right, then kneeling, the angle formed by the legs being about  $60^{\circ}$ , as in the position of the soldier.

Since our rifles all have the stacking swivel, and will continue to have it if desired, why not abolish entirely the "Stack Arms" with the bayonet, instead of saying that "stacks will not be made with the bayonets if the rifles have the stacking swivels"?

We have been given a great improvement in the firings; the prominence given to volley firing is especially to be desired.

#### SCHOOL OF THE COMPANY.

Paragraph 179. "The company is grouped into squads, under the leadership and immediate control of the non-commissioned officers, who are held responsible for discipline and order in camp and quarters, and are trained as leaders of groups for battle."

Paragraph 180. "The four or squad consists of four files, a corporal and seven privates; the corporal is the squad leader."

Paragraph 182. "Two or three squads form a section under a sergeant, as chief of section; the section is used in the extended-order drills; it is not a subdivision for movements in close order."

Paragraph 183. "The company is divided into platoons, each platoon into two sections."

The corporals are now placed on the left of the front rank of the different sets of fours, the 1st sergeant is a file closer and belongs to no section, and the other sergeants are placed conveniently to perform the duties of chiefs of sections and as guides.

These are the most important changes in the School of the Company, and on these changes are based the exercises in extended order, which tell us how we are to approach and fight our enemies. They will work well in close order, and in extended order they will enable us to contend on equal terms with any civilized foe. Call the group by whatever name we please, something of the kind must be adopted and the methods of the great nations

of Europe followed in depending more on our non-commissioned officers, heaping more responsibilities on them and trusting them more than ever.

"Rear, open order," now belongs to the past and we have in its place, "Open ranks." Guides and enlisted men in the line of file closers, when excused from executing the manual of arms at drill, remain at order arms. "Guides in front marking the line stand at the order." "A non-commissioned officer as guide, or in command of a subdivision or detachment, carries his rifle as the men do." The distance between front and rear rank in column of fours, is now 44 inches instead of 32, and the leading and rear guides take 44 inches instead of 21, from the men next in rear and front of them respectively.

In executing "On right into line" the rear rank of each set of fours closes to facing distance as the front rank commences to wheel; in executing "Front into line" it does so upon halting. Perhaps the rear rank closes in the first instance, in order to get promptly out of the way of the next four in rear. In facing a squad to the rear we say "About Face"; when applied to the company we have to prefix to those commands, another "Company."

In all the School of the Company no instance has been found where the captain has given the commands for dressing the company at the end of a movement, and only one, paragraph 236, where such commands have been given by a lieutenant.

No time is saved by this, as the men will invariably require correction—some will always have to be told to dress to the right or left and the dressing will be better done at command.

We now have no changes from double to single rank and back again, but to keep the "School of the Company" up to its old length, we are given some new platoon movements, easily executed and perhaps good to have.

There are a number of other smaller changes. The distance between ranks in marching at route step is now 36 inches; the post of the captain in column of platoons is now 3 paces from the flank of leading platoon, etc.

#### SCHOOL OF THE BATTALION.

There are a great many important changes here. Almost immediately we see that "the movements explained herein are on the basis of a battalion of four companies," which is a long step

towards a three-battalion organization for infantry regiments, now adopted by every powerful nation except ours.

The color-bearer has a guard of only two men, who stand in the line of file closers, while he and they belong with no particular company, but must keep in the centre of the battalion. The color-bearer no longer takes post six yards to the front, the battalion marching in line. The present posts of field and staff give a much better arrangement than the old one, which was top-heavy with its two field officers,—whose work can easily be done by the adjutant and sergeant-major,—and its staff thirty yards away from the battalion, except at open order or at ceremonies. The adjutant and sergeant-major are the proper persons to look after the guides, which work was formerly supposed to be done by two field officers.

No advantage is seen in the new position of the band—twenty-four paces instead of twelve yards from the right flank of the battalion in line, etc.

The language in the beginning of paragraph 257 is either vague in describing how to form the battalion, or it describes a rather loose manner for so doing. It is certainly more military to have the adjutant and sergeant-major march together to the place where the base company is to form, than to have them proceed there separately after Adjutant's Call has been sounded and the companies are coming along to take their places in line.

The interval of three paces between companies is an improvement in that it should prevent the crowding in ranks which so often occurred with the battalion marching in line.

Both guides preceding the company on the line follows as a consequence of the three-paces interval.

"Open ranks" has again taken the place of "Rear, open order," but does not better describe the movement to be executed. The improvements in the firings are also given in the School of the Battalion.

There are no longer any general guides nor markers, neither being needed now.

The battalion wheel was a slow method of changing front, and it has been well omitted; also the double column of fours, and of companies, the two last movements being no longer necessary with small battalions of four companies. Paragraphs 302 and 303 describe two movements which should be very useful in marching through the broad streets and narrow alleys of

our large cities, the change from column of fours to column of companies and the converse, at the same time changing direction to the right or left.

Marching by the flank of sub-divisions has changed its name, being now called "Marching in line of companies in columns of fours."

Paragraphs 325 and 326 describe how to form front into line of companies in columns of fours; from column of fours, also on right or left into line, etc., both of them good movements taken in connection with the exercises in extended order.

Closing intervals as described in paragraph 332 may be useful in enabling the battalion to cover less ground and thus often conceal its exact whereabouts. Changing the distance between sub-divisions in close column from 6 yards to 8 paces is a very small departure from the old rule.

The new methods of plying into close column are better than those we have practised so long. "Close column is always plied with the designated or leading company in front."

In this new way of executing the old "To the right (or left), close column of companies," it makes no difference whether the column of fours *is* right or left in front.

The changes from double to single rank and the reverse are again omitted in obedience to paragraph 1, which is closely adhered to throughout the movements in close order.

In advancing in line the guide of the battalion is now the left guide of the right centre company, and there is no "basis of alignment" as there used to be.

A new method is followed in giving the battalion a general alignment; the guides of some one company being first placed on the line, and the other guides both left and right of each company then put on the same line, without the colors.

Obstacles are more sensibly passed in our new drill book, and four lines are enough to tell each captain how his company is to pass the obstacles in its front without the assistance of the battalion commander.

The closing in mass and taking wheeling distance as explained in the new text are briefly and well told. We have no more divisions, nor wings, and their absence will be to our advantage.

A number of platoon movements have been added which are of doubtful benefit.

Throughout the School of the Battalion little mention is made

of the posts of officers. I believe this is wrong, and that the position of the company commander should be so described as to leave him no excuse for playing the instructor and going wherever his presence may be supposed to be necessary, he being no longer the instructor.

#### STREET COLUMN.

We needed some regulations relative to movements in the streets of cities and those furnished us are about all that are necessary.

#### EVOLUTIONS OF THE REGIMENT.

For Evolutions of the Brigade, according to Upton, we now study Evolutions of the Regiment; the brigade drill was written for four battalions, its substitute gives us three battalions in theory and something to hope and wish for.

The contents of seventy-two pages of the old book are replaced by those of thirty-two pages in the new one, omitting "Passage of defiles," "Passage of lines in action," and the four pages describing the changes from double to single rank and the converse, also part of the echelon drill.

The four pages in the old text, explaining how to close in mass and to take wheeling distance, have been condensed into two small paragraphs in the new drill regulations—411 and 412—and the changes of front are told of in one paragraph of seven lines.

Movements by divisions have, of course, been omitted. In many instances the commands for practically the same evolutions have been changed, being now shorter and fewer in number, as a rule.

But with the exceptions of the parts mentioned as omitted, which comprise about ten pages, the old brigade drill is all given in our present Evolutions of the Regiment, and in better shape.

In our new text-book the movements of larger bodies of troops than a regiment are exceedingly few and of the simplest. "The regulations for the evolutions of the regiment are applicable to the brigade."

The principles prescribed for the evolutions of the brigade apply to the division.

"The principles prescribed for the evolutions of the division apply to the corps or a larger command."

Excepting the few commands, such as "Forward" or "Halt," which can be given through the trumpet, staff officers, orderlies, or other messengers must be used in transmitting to his subordinates the wishes of the commanding general.

History is full of examples where the general's commands have been miscarried by his messengers, or misunderstood by those who received them. It is not easy to transmit to a third person the spirit and wishes as well as the language of a message given under excitement, and, perhaps, through a misconception of the true condition of affairs.

As much as possible the general's commands should be written as well as explained orally. A few scribbled lines found in Nolan's pocket would have prevented much controversy, or, better still, if delivered by him would, perhaps, have produced a result different from that which actually happened.

#### EXTENDED ORDER.

There is no doubt that the exercises given us in extended order are far ahead of our old skirmish drill. All the great military powers long ago adopted a smaller fighting unit than ours, which was the company. Lieut. Reilly, 5th Artillery, gave in 1889 the outline of a system which recommended the squad as a fighting unit, placing a corporal on the right of the front rank of each set of fours, and putting him in charge of the squad after extending order. In our present drill regulations we have the corporal on the left of the front rank of each set of fours, while in line, and throughout all the exercises in extended order he plays an exceedingly important part, leading his squad, teaching the men to follow him and to obey the slightest caution or gesture. He is their immediate commander after deployment as skirmishers, the same as while forming line of squads, and having been their instructor in all the exercises pertaining to one squad, is responsible for the drill and much of the discipline of that body of men.

It remains to be seen how well placed is the confidence thus bestowed on this class of non-commissioned officers, for a corporal never before has been in any position where he has had it in his power to do so much good or so great an injury. This change makes him in a great measure responsible for success or defeat.

While the squads are being thus taught in those matters upon which the drill, discipline and efficiency of the company depend to a great degree, the company commander cannot afford to stay

away from the drill, but must be ever present to see that those men who never before have had such responsibility, now acquit themselves in a manner which will bring no discredit to him as their chief.

Among the general principles applying to movements in extended order are the following:

"The squad is the basis of extended order, men are taught to regard the squad as the unit from which they ought never to be separated. Officers and sergeants will give their attention to preserving the integrity of the squads.

"This instruction on account of its importance will be given as soon as the recruits have had a few drills in close order.

"Men in extended order fix their attention at the first word of command, the first note of the trumpet, or the first motion of the signal; the movement commences immediately upon the completion of the command, trumpet call or signal.

"Extended order may be taken from any formation.

"No commands for dressing are given in extended order; the general alignment is taken towards the base file; the men stand and march at ease and pay close attention."

Under the heading "Leading the squad" we see that "the movements are executed at signals from the corporal, and as far as possible, without commands or cautions; the object being to prepare the squad for the battle exercises by training the men to coöperate with their leader and conform instantly to his wishes.

"The corporal is posted three paces in front of the squad, which conforms to his signals and movements.

"The squad is exercised in turning, marching," etc.

"The man in front of whom the corporal places himself is the guide of the squad, and follows in the trace of the corporal at a distance of three paces," or the corporal may announce the guide.

"When the squad is marched to the rear, the corporal takes position in front of the squad."

In practice it will be found best to combine signals and commands for awhile, and gradually leave off commands.

The squad may be deployed as skirmishers, forward or by the flank; forward, if on the march and in rear of the line to be occupied; by the flank, if at a halt and already on that line, the interval between skirmishers being two paces, unless another interval is given in the commands.

"Before giving the commands for marching, deploying, or

assembling, or for increasing or diminishing intervals, the corporal indicates the file which is to be the base or guide, places himself three paces in front of it, and indicates the direction," and "on halting, places himself three paces in rear of his squad.

"The deployment as skirmishers is made on the front rank man of the second file from the right.

"The rear rank men place themselves on the alignment to the right of their file leaders, each as soon as there is interval"; this places No. 2 front rank in the centre of the squad in extended order.

Having deployed, the squad may be marched to the front, faced to the rear and marched to the rear, marched by the flank, may change direction, extend and close intervals, rally, assemble, execute the firings, etc.

While on the march, either before or after deployment, moving to the front or to the rear, the position of the corporal is three paces in front of his squad; when halted, he takes place in rear.

In rallying, the squad takes such formation as the corporal may direct, fixing bayonets, and may move forward after rallying, following the corporal in double or single rank as he directs.

Being rallied or deployed the squad may be assembled, the members always in their proper places, and may move forward, following the corporal.

"When the preceding movements are well understood, they are executed at signals."

This is one of the most important features of the drill and is very quickly learned.

It will enable the skirmish line to approach unseen much nearer than if the commands were published through the trumpet or by word of mouth.

"The firings are always executed at a halt. If the squad be in march, it halts at the preparatory command for firing, etc.

"Volley firing is executed, the squad closed or deployed, by the same commands and means as in close order. More than three volleys will rarely be fired without intermission; this to allow the smoke to clear away, to steady the men, and to prevent waste of ammunition."

This class of firing is used at ranges beyond 800 yards, also "at extreme ranges if the enemy is in large bodies," and ammunition plentiful.

"The fire at will and the fire with counted cartridges are used at distances ranging from 800 to 400 yards.

"The rapid fire is used at short ranges at the decisive moment of the action."

It would be difficult to get up a better set of regulations than those furnished us, describing the duties of the squad in extended order, especially those relating to the firings.

The exercises showing the use of cover are excellent and should be carefully taught.

Hunting is excellent preparation for such work.

The direction that in the squad's "battle exercises," "blank cartridges should frequently be used," is very necessary in order to bring conditions of the drill ground nearer to what happens on the battle-field, and will be of some assistance in keeping down excitement when a real foe is in front.

The movements connected with the rally admit of every application of common sense to such a formation, but it has been contended that the rally should not be attempted, since it must deprive the skirmishers of much valuable time that cool men could utilize in firing at the advancing horsemen, and it must have a tendency to increase the skirmishers' excitement and render them less steady and accurate as marksmen.

An infantry skirmish line should not consider their part of the fight as lost merely because they fail to drive back charging cavalry before they reach the line. If they remain reasonably cool and keep up the fire, they must win beyond a doubt without rallying, unless heavily overmatched in numbers, in which case rallying would not save them. It seems to me that the rally is a mere bluff, covering a confession of weakness.

The general rules given to obtain and enforce fire discipline are excellent; in order to keep any control over the men they must be taught to fire only when ordered, and only the number of rounds ordered. The attention given to volley firing is heartily endorsed. From examination of the company annual target reports I have noticed the high percentage of hits at volley firing in comparison with that made in company skirmish firing though at longer ranges. This is due of course to the distances being known and the firing more quietly done, but in most cases the officers would be able to tell pretty well the elevation to be used by their men, and by their personal attention would rectify or prevent any great errors.

The text is not clear enough in describing the cadence used in deploying as skirmishers; par. 523 says "increased cadence" and 524 uses the word "rapidly."

#### PLATOON.

The platoon may form line of squads or skirmishers, the chief of platoon first designating the centre squad and indicating the point of direction to the squad leader.

Line of squads may be formed forward or by the flank. The platoon in column of fours may form front into line of squads, or, on the right or left into line of squads.

Line of squads may be deployed as skirmishers at any time after the commencement of the movement to form line of squads, which is executed by each squad when it arrives on the line.

"In exceptional cases the platoon may be deployed in the same manner as a squad," either forward or by the flank.

"One section may form the firing line, the other the support; or the entire platoon may be placed in the firing line."

While the line of squads is being formed we notice that the chief of squads has his old place as leader; in the deployment as skirmishers he is a skirmisher in the line, having deployed in his proper place as No. 4 front rank.

The chief of section is six paces in rear of the line of squads or skirmishers, or, if in command of the support, six paces in front of it, the chief of platoon being between the firing line and the support.

The platoon may extend or close intervals of squads or skirmishers on a designated squad; in the latter case intervals being taken from No. 2 front rank of the base squad.

When the platoon is assembled the chief takes post where it is to form before signalling or giving the necessary commands.

The assembly of squads may also be executed, each squad assembling as if alone.

In marching, whether to the front or rear, in line of squads or skirmishers, the chief of platoon is careful to indicate the point of direction to the chief of the base squad.

In making a considerable change of direction, the pivot squad, which is the base, changes direction as if alone, and halts; the others conform to the new alignment.

The firings may be executed by squad, by one or more indicated squads, by section or platoon; all as explained for the

squad, the corporals taking part in the firings, except when the fire is by squad.

"Volley firing may be used when the front is of such extent as to be controlled by the voice.

"A section constituting the firing line executes the preceding movement by the same commands and means, under the orders of the chief of section."

In line of sections "the normal interval between sections of three squads each is about forty-five paces; between sections of two squads each, about thirty paces," the interval between squads being about fifteen paces.

"The platoon forms line of sections, marches in this formation, and increases and diminishes intervals between sections as explained for squads, substituting *section* for *squad* in the commands and explanations."

The section executes all the movements in extended order as explained for the platoon.

In reinforcing the firing line the method called the group reinforcement will be used when practicable. By this means the reinforcing group fills an interval all by itself without mixing with the other skirmishers.

The rally may be executed by platoon, by section or by squads; in the first case, the chief of platoon indicates the rallying point and signals or commands; in the others, the chiefs of sections and of squads, respectively, indicate the rallying points and make the necessary signals.

"When, as a result of reinforcing, sections and squads are mixed, each group rallies on the chief who commands it at the time."

The reason for placing the chief of section and the chief of platoon now only six and ten paces respectively from the skirmish line, must be looked for in the increased deadliness of fire-arms, and the consequent increase of nervous excitement of the skirmishers, which calls for more care and personal attention from their immediate commanders.

This question, in a very great degree, depends upon the previous experience and length of service of the men composing the firing line.

We know that in times past, when enlistments were much longer than now, the opposing lines approached very close to each other, as at Fontenoy, where the French and English, each

insisted on receiving the first fire. Such coolness in danger is not to be expected in these days of short service and tendency to shorten the term still more.

#### THE COMPANY.

Under the headings, "The Company" and "Positions and Duties of Officers," will be found, given in as few words as possible, good descriptions of the different battle formations of a company, whether alone or part of a battalion, on the offensive or defensive, and of the positions and duties of all the company officers.

Acting alone, the company is in three echelons, if part of a battalion, it is in two; on the defensive the firing line is much stronger in the beginning than on the offensive.

The first echelon is the firing line, the second the support and the third the reserve.

"The company forms line of squads or sections, deploys as skirmishers, increases and diminishes intervals, assembles, rallies, and executes the marchings and firings by the commands and means prescribed for the platoon.

"The captain is the instructor. He takes post between the firing line and the support, or, if the formation be in three echelons, near the support. He designates the sections for the firing lines, support and reserve, directs the action of the whole company, *controls the reinforcement* of the firing line and keeps up the supply of ammunition, regulating distribution and expenditure. His orders, given by word of command, signals or delivered by orderlies, are directed to the commanders of the firing line, support and reserve. A musician remains with the captain.

"The 1st Lieutenant commands the reserve, if there be one, otherwise the support.

"The 2d Lieutenant commands the firing line when it consists of only one section, or of one section from each platoon.

"The 3d Lieutenant, if there be one, may be assigned by the captain; if the formation be in three echelons, he usually commands the support.

"The 1st Sergeant, if not in command of a platoon or echelon, takes post near the captain.

"If the firing line consist of an entire platoon, it is commanded by its own lieutenant; the other lieutenant commands the support or reserve.

"The commanders of echelons give the commands necessary for the execution of the orders of the captain," etc.

"Before forming for attack or defense the commander 'of a force acting alone makes the reconnoissance necessary to determine the best disposition to be made.

"Commanders of companies and larger units forming parts of larger commands throw out scouts in their immediate vicinity," etc.

The company being part of a battalion on the offensive, "when first coming within the zone of artillery fire, is formed in line and advances until the artillery fire becomes effective (on open ground, 2500 yards from the enemy)."

The captain then orders forward a few scouts who advance at an increased gait unless the company be halted; he designates preferably the second and third sections for the firing line and gives instruction for the extension. Then orders the battle formation when the scouts are 150 yards to the front. The firing line having advanced about 200 yards, the support is put in march.

A diagram in the text represents this state of affairs; the captain with the 1st Sergeant and a musician in his rear being about midway between the firing line and the support, in rear of the centre of the former, and the sections of the support opposite their places in the company.

The firing line forms line of sections at about 1400 yards from the enemy, line of squads at about 1200 yards, deploys as skirmishers at about 900 yards, and at about 800 yards or less may find the scouts waiting for it.

Firing is put off as long as possible, though volleys may be sometimes used against bodies of the enemy who show themselves, and when the advance should no longer continue without firing the captain directs the number of volleys to be fired at each halt.

The commander of the firing line never exceeds the number of volleys directed by the captain "but may reduce the number or omit the firing, to avoid a mere waste of ammunition."

The firing line is now closing in on its centre to make room on the outer flanks for the support which has been drawing nearer without waiting for orders. The firing line gains ground by rushes executed by the whole line if possible; when arriving within about 500 yards from the enemy "rushes by alternate sections will probably be necessary."

In the text this is described, the commander of the firing line giving the commands and the rushes being for 30 yards at a time, except the first which carries one section 15 yards to the front.

"Volleys will be used to the last practicable moment."

Par. 592. "During this period of the attack, as soon as it becomes necessary to increase the intensity of the fire, the captain *sends* forward the supports to reinforce the firing line."

The group reinforcement is used. Each lieutenant now commands his own platoon, and the rushes may be by alternate platoons.

"In emergencies the commander of the support may reinforce without waiting for orders.

"As the company approaches the enemy's position the captain selects favorable ground from which to make the assault, and having attained this position commands 'Rapid fire.'" Platoon commanders have bayonets fixed, sights laid down, and give commands for rapid fire kneeling. Any supports still in rear join at the command for rapid fire.

"The captain gives the necessary commands for advancing to the charge and on arriving at about 30 yards from the enemy gives the command 'Charge.' The men charge bayonets, quicken the pace and advance upon the enemy."

This practically ends the description of the company's battle; if successful, the retreating enemy is punished as much as possible, if unsuccessful, a second attempt will be made.

The several explanations as to the duties of the support are confusing, either too much or too little is said on the subject.

As long as the captain is on the field and able to command I cannot see what "Emergencies" could justify the commander of the support in advancing without waiting for orders. From the position assigned the captain he is surely nearer the firing line than his lieutenant, and the support in advancing would have to pass very close to him. If the captain is not to be found or is disabled, of course the commander of the support would exercise his own discretion in the matter, but such an emergency might well be mentioned, otherwise the text appears to give the captain too little control over the action.

In par. 592 the captain *sends* forward the supports, but when the rushes are made by platoon it is surely he who gives the commands. The text should tell us more about the movements of

the captain in the different stages of the battle, he appears to have too little to do with it.


A certain amount of firing while moving on the enemy's position, as indicated in the text, is indispensable. If the enemy's fire is not returned at all, his men use their rifles without the nervous excitement caused by imminent danger, and coolly shoot down the advancing soldiers without fear.

The Russians and Germans discovered in their last wars that the Turks and French did much less execution on them when subjected themselves even to such a fire as an advancing line can deliver. They profited greatly by the discovery.

The distance for each rush is given as about thirty yards. I cannot believe that the text is meant to be mandatory at this point, and strongly object to the rush by alternate sections. While one section is firing several volleys the other rushes to the front and most likely is in its new position when one or more volleys are fired by the first section. There is no interval between sections, and at this stage of the battle the skirmish line has been closing on its centre and the two-paces interval between skirmishers has become less. Even supposing that a section rushes straight to the front there will be a number of men on the flank very little removed from the front of the men on the adjoining flank of the firing section, and, owing to the rapid firing and consequent smoke, the intense excitement, and sometimes fear of those firing, there must necessarily result a number of casualties, and men will object to such rushes, feeling that some of them will almost surely be shot in the back by their friends in rear.

It would be much better not to have alternate rushes executed by smaller bodies of men than a company in each rush.

Discussion on the subject in the officers' lyceum at this post gave rise to the above-expressed fear relative to the rush by alternate sections, and I believe we were unanimous in our opinion as to the danger.

The interval of fifteen paces between companies, as shown in the extension of the battalion, would make the rush by company perfectly safe. There is no question as to the advantage of having the advance executed by rushes of alternate bodies of troops, but there should certainly be an interval between adjoining commands which are to advance by rushes, and the rush should be either to gain cover or for a longer distance than thirty yards. 

No mention whatever is made of any assistance from the battalion reserve, which seems very odd. It would hardly be natural for the battalion commander to expect half his command to perform a duty which, perhaps, might be too difficult for the whole.

In cases similar to this, further on, assistance is given by the battalion or regimental reserve.

The firing line is relieved about as prescribed in the old text.

The attack of the company acting alone is conducted on the principles explained for the company in battalion, the support being used to protect the flanks and assist the front attack, and the reserve to make a flank attack or take part in the front attack, being 150 yards from the firing line when the support joins it.

The company in battalion acting on the defensive has, of course, different duties, but "the division and formation of the company are, in general, the same as on the offensive." The front and flank are well reconnoitred and the position to be held well prepared for defense. The scouts cause "the enemy to deploy and disclose his intentions. The captain then orders the battle formation." "Fire is opened as soon as it can be made effective." The support is absorbed in the firing line when the enemy is about 500 yards distant, and the defense continued with the assistance of the battalion reserve.

The enemy's support and reserve are fired upon whenever it can be done to advantage.

The company takes the offensive, or withdraws and forms at the rallying point, according to the result of the fight.

We notice that the battalion reserve assisted in the defensive battle, though it failed to do so in the attack.

The company being alone and on the defensive, if it arrives at the position to be defended in battle formation, the firing line is promptly established, the support and reserve placed under cover, and patrols sent out to reconnoitre the front and flanks. If the company be in order of march the advance guard halts at the position and sends out scouts and small patrols.

"The captain makes the preliminary dispositions as explained for the company in battalion, then takes the battle formation."

The company being alone, the support and reserve are so disposed as to guard the flanks, and the firing line made very strong in the beginning "in order to secure superiority of fire and a front at least equal to that of the attack," the supports being used for

this purpose also. Part of the reserve is kept back, to execute a counter attack the moment the enemy reaches the position, or to cover the retreat. Energetic counter attacks upon the enemy's weak points are prescribed whenever opportunity offers. The enemy being repulsed should be punished as much as possible and pursued, if such would not endanger the security of the position.

If necessary to retreat, it would be done with the assistance of that part of the reserve not already absorbed, placed near one flank if possible and so disposed as to hold the enemy in check while the firing line unmask the reserve and takes position in rear of it.

The reserve then retires under the protection of the firing line, the company thus moving from one position to another and finally taking the column of route when out of range of the enemy.

"Unless ordered to the contrary, a position should not be abandoned except in the last extremity."

On the defensive, the company being in battalion or alone, the text demands that the firing line shall be very strong in the beginning, and for the company acting alone, that the flanks be well protected. Of course the strength of the position will aid in determining the strength of the firing line.

#### THE BATTALION.

602. "The principles of instruction for the squad, platoon and company in extended order apply." 603. "The battalion is formed for battle in three echelons; a firing line, a line of supports and reserve. In battalion, the firing line and supports together are designated the fighting line; it may be composed of one, two or even three companies."

Under the heading "Extension," is briefly and well described the manner in which a battalion takes the battle formation.

A diagram shows the battalion after extending. The reserve, composed of the two flank companies, apparently, has not moved from its original position in line; 300 yards to the front is the line of supports, a platoon opposite each flank of the firing line, which is 200 yards farther to the front in line of sections, one of the platoons of the support being in line of sections also. The scouts are 150 yards in advance of the firing line, the major being between the reserve and the line of supports.

In the firing line we see an interval of fifteen paces between

companies, no reason is given for it, but we are glad to see it there for the protection of the company which rushes to the front.

"The firing line extends as directed by the major, and according to the principles explained by the company." "Mounted officers dismount when the battalion opens fire." The color, if present with the battalion which takes the battle formation, is sent to the rear to join the regimental reserve.

It goes against the grain to have the color in the rear during the entire battle, and after it is over perhaps carried around by its small guard hunting for its proper regiment. A little more explanation as to the use and whereabouts of the color during battle would be most acceptable.

The band, too, is evidently put away for fair weather use only, no mention being made of it.

The general rules for the battalion define well the duties of the major and captains.

"The major regulates the progress of the action, etc.; leaving the execution of details to his subordinates, he exercises a general control, and endeavors constantly to increase the energy of the action."

The major of a battalion in a regiment on the offensive, having received orders to attack, gives his instructions for the extension and orders the battle formation.

"The companies in the fighting line conform to what has been prescribed for the company. The reserve conforms to the movements of the fighting line," etc.

The attack is made as prescribed for the company.

"When the firing line is about 500 yards from the enemy's position, the first echelon of the reserve is about 100 yards and the second about 200 yards in rear of the firing line."

The reserve is put on the firing line as the major thinks necessary. "At about 200 yards from the enemy bayonets are fixed and the rapid fire is opened," the last of the reserve being still held back, but in readiness to reinforce the line.

The battalion in the second line draws nearer to replace the battalion reserve and to take part in the charge.

If the enemy is not shaken by the rapid fire the last reserve is quickly brought up, another rush made, and again the rapid fire; "during this fire the battalion of the second line reinforces the firing line; at the signal from the colonel, the field music sounds the charge and the whole line rushes upon the enemy."

Having carried the position the advance is continued till a position is found favorable for further firing upon the enemy, and for making preparations to pursue the enemy or to resist a counter attack.

"If repulsed the line rallies under the protection of the reserve."

In the last paragraph the "reserve" meant must be the third line of the regiment, for "the battalion in the second line" joined in the final assault and repulse.

Earlier in the description of this battle, by the "first echelon of the reserve," the line of supports is understood, and by the "second about 200 yards in rear of the firing line," must be meant the reserve as shown in the diagram.

It is seen that the rapid fire is opened at about 200 yards, one rush made after that, when the battalion of the second line joins and takes part in the charge which, at the colonel's signals, is sounded by the field music. Of course the distance given will vary according to such circumstances as approaching darkness or vicinity of woods, hills, etc. I do not understand what field music would sound the charge unless several field musicians have been held back for this purpose and to act as messengers.

The action of the battalion acting alone "is conducted on the general principles explained for the battalion in regiment," the same attention being given to the flanks as in the case of the company acting alone.

With the battalion in regiment on the defensive "the reconnoissance and occupation of the position are made on the principles explained for the company acting alone," etc.

"As a rule the battle formation is the same as on the offensive."

If desired to have an extended and dense firing line from the start, the companies on the fighting line may hold only one section each in support. The points commanding a clear field of fire and affording cover are strongly occupied; the different parts of the front should be able to assist each other; hasty intrenchments are used if practicable; the strong points of the line are placed in a state of defense, etc.

"The strong points are connected by shelter-trenches, intervals being left to facilitate counter attacks and for passing from the defensive to the offensive.

"The action is conducted according to the principles explained" for the company in battalion on the defensive.

The enemy being distant about 500 yards, part of the reserve is put in the firing line, the supports being already absorbed.

"In the last stage of the action, the firing line may, if necessary, be reinforced by the entire reserve.

"If retreat becomes necessary, it is conducted as prescribed for the company. When all the battalion reserves have been absorbed on the firing line, the troops in the second line take position and protect the battalion while rallying, or by an energetic counter attack endeavor to gain the ascendancy."

When the battalion in regiment advanced to the attack, it was assisted at the final assault when help was most needed, by the battalion of the second line, and in case of repulse, rallied "under the protection of the reserve" (third line of the regiment).

It seems a faint-hearted defense when the battalion of the second line takes no part in it till the firing line, composed of the entire first battalion, has been drawn back and needs protection while rallying. Before that becomes necessary the entire battalion of the second line, and, perhaps, the third battalion, should bear their full share of the fighting, and an honest, vigorous effort should be made to hold the position. This would be much better than an easy, safe retreat, and an attempt to retake the position from the enemy flushed with victory. Too many men are apt to take and use all the discretion allowed when such a question as this arises.

With the battalion acting alone on the defensive, "the general principles stated for the company acting alone apply," due care and preparation having been given to the protection of the flanks.

#### ACTION AGAINST CAVALRY.

The rules laid down in the text are excellent.

"As a principle, the advance or attack of infantry should not be checked by the appearance of cavalry," sub-divisions being designated to use volleys against it.

If in line and attacked by cavalry, the charge is received without change of formation or other change except that of front, if necessary.

"If in battle formation, and the cavalry attack as foragers or in mass, it is better to receive the attack at a halt than to rally." Such dispositions are made as will quickly develop the greatest intensity of fire, the flanks to be well protected by the support.

If attacked in flank the support and reserve face so as to find themselves in echelon ready to protect the threatened flank by their fire.

For a battalion, "if there be time, the major may place the companies in echelon," the echelons so arranged, by advancing companies on the flank best protected from artillery fire, as to bring as many rifles as possible to bear on the cavalry.

These rules are sufficient as far as they go, but they are surely too brief to meet all possible requirements.

That the line of skirmishers should receive the charge of cavalry as foragers or in mass without rallying, has been proven in the battle-field, and I believe that the American soldier is of all best fitted for such work, having all the individuality of the Frenchman, with all the Englishman's nerve and pluck.

And though it is said that the German cavalry charges as a solid wall, I see no good reason why American infantry should ever fail to stand firm against such a charge if simply in line in close order.

Of course if infantry is already shaken, through loss of men, ammunition or courage, it is not in perfect shape to stand such a cavalry charge, boldly led by the right sort of a leader; and more than one prominent military writer asks how the cavalry is to find out if the opposing infantry is shaken unless a bold charge is directed against it. Bredow objected to charging "unshaken infantry," but found that he was mistaken and that the infantry opposed to him, were, though very numerous, far from being unshaken. Although the infantry Bredow rode through and through were not Americans, they were good soldiers, and it behooves us of the infantry to remember that lesson and not to underrate the dangers of a cavalry charge properly led by the right man, but to make every possible preparation for just such a charge as Bredow's.

#### DEFENSE AND ATTACK OF ARTILLERY.

"Infantry under artillery fire seeks to lessen its effect by appropriate formations and use of cover."

#### DEFENSE.

"An infantry support for artillery protects the flanks and rear of the batteries and opposes the enemy's infantry or cavalry acting against them; it is usually posted on the flanks."

This for the company; and for the battalion, "the companies are posted in front of the intervals between groups of batteries and on the flanks, so as not to hinder the fire of the artillery; they are held ready to meet the attack."

#### ATTACK.

"The company is disposed as for the attack of a position, but the firing line may be deployed as skirmishers at a greater distance and the front may be more extended; the rear echelons if need be are also deployed."

"When the artillery is in motion, the fire is directed preferably upon the horses."

"The battalion is disposed as for the attack of a position; the parts in close order advance in echelons and thin lines; the advance is led on as rapidly as possible, and the attack precipitated when within a short distance of the guns."

The attacks should be made against a flank if possible, and a sufficient force directed against any infantry support to silence its fire.

Again it is believed that the text has been too brief; the regulations, though excellent, are not full enough.

The best artilleryman of recent times in foreign wars believed that artillery unaided need not abandon the field to the infantry, and cited examples from the Franco-German war to support his belief.

That he did not have the fullest confidence in our arm was shown when he told that at Königgrätz about 500 Austrian infantry fired at 10 or 12 horsemen including himself at 20 or 30 paces, without hitting anything except one horse, "most of the shots going straight up into the air"; and said that when he first joined, old veterans had assured him "that it was an evidence of a certain degree of instruction, if, in the heat of action, the men raised their pieces to their shoulders to fire."

The principal fault found with the new text book is the brevity of the explanations, especially of those movements not contained in the old book. In many instances clearness of expression has been sacrificed to brevity. A line or two, here and there throughout the book, would have saved many requests for information. The numerous questions that have already appeared in the *Army and Navy Journal* prove this to be true, and the fault is not with the understanding of those seeking information,

but with the wording of our drill regulations in which all movements should be explained so clearly as to remove all doubt as to the meaning intended to be conveyed. One can easily see from study of the book, that it was the intention of the writers to condense explanations, but it was carried too far. But in any case the movements in extended order carry us a long step towards the front rank of those most skillful in the battle-field ; the principles laid down are those now generally recognized as the best, and that part of the book which treats of extended order will become more popular with time, study and practice.

## Comment and Criticism.

(The remarks under this head have, generally, been invited by the Publication Committee, which desires that, as far as practicable, these "Comments" should appear under authors' names.)

### I.

#### "The Organization of Militia Defense."

Col. Ernest Macpherson, Judge-Advocate-General, Kentucky State Guard.

THE militia men who read in the September number of the JOURNAL the article entitled "Organization of Militia Defense of the United States" will find it interesting, instructive and pleasing. It treats of a subject in which every member of the State Guards ought to be deeply concerned. It contains the views of a regular soldier, skilled in his profession, and presumably competent to devise a wise scheme of militia organization; and it is evidence that officers of the regular army are alive to the propriety, if not necessity, of a change in the organization, administration and discipline of the amphibious soldiery known as "the militia," from which must come the real army of the United States in time of war.

The officers of the regular army may always rely with confidence upon the cordial support of the militia in securing the enactment of laws to effectuate any feasible plan for the improvement of the efficiency of the State Guards. It should seem, however, that the plan advanced by Captain Chester is quite impracticable, unless the Federal Constitution should be amended so as to meet the particular case. This, if desired, is not to be expected. It is certain that such an amendment if carried through Congress would fail to be "ratified by the Legislatures of three-fourths of the several States." The militia of a State represents that reserve power in its political sovereignty which authorizes it to resort to force, in order, if necessary, to execute its laws; and the recent history of the United States shows that the necessity for the employment of the militia is more likely to arise in the administration of the government of a State than in that of the United States. Whatever power the States may now have over their militia it may be assumed they will never willingly relinquish.

The article under consideration seems to contemplate, *in time of peace*, Federal control of the militia, the appointment by the President of various officers, and the reorganization of the militia in disregard of State lines. It becomes important, therefore, at the outset to determine what is the "militia of the United States," and what the powers of the Federal and State Governments in the premises, and the manner in which this military force may be legally employed.

"Our understanding is, that the organization of the active militia of the State conforms exactly to the definitions usually given of militia. Lexicographers and others define militia, and so the common understanding is, to be 'a body of armed citizens trained to military duty, who may be called out in certain cases, but may not be kept on service like standing armies, in time of peace.' That is the case as to the active militia of this State. The men comprising it come from the body of the militia, and when

not engaged at stated periods in drilling and other exercises, they return to their usual vocations, as is usual with militia, and are subject to call when the public exigencies demand it. Such an organization, no matter by what name it may be designated, comes within no definition of 'troops' as that word is used in the Constitution. The word 'troops' conveys to the mind the idea of an armed body of soldiers, whose sole occupation is war or service, answering to the regular army. The organization of the active militia of the State bears no likeness to such a body of men. It is simply a domestic force as distinguished from regular 'troops,' and is only liable to be called into active service when the exigencies of the State make it necessary." (*Dunne vs. People*, 94 Ills., 120.)

Section 8, Art. I, of the Constitution, gives Congress power "to provide for calling forth the militia to execute the laws of the Union, suppress insurrections, and repel invasions; to provide for organizing, arming and disciplining the militia; and for governing such part of them as may be employed in the service of the United States, reserving to the States respectively, the appointment of the officers, and the authority of training the militia according to the discipline prescribed by Congress." Sec. 2, Art. 2, provides, "The President shall be commander-in-chief of the army and navy of the United States, and of the militia of the several (*sic*) States when called into the actual service of the United States."

"Remember always" said Daniel Webster, "that the great principle of the Constitution on that subject is that the militia is the militia of the States, and not of the general government; and being thus the militia of the States, there is no part of the Constitution worded with greater care and with a more scrupulous jealousy than that which grants and limits the power of Congress over it." (*See Works*, Vol. 2, page 95.)

Mr. Justice Story, in his opinion given in the case of *Houston vs. Moore*, (5 Wheaton, 50) said: "It is almost too plain for argument, that the power here given to Congress over the militia is of a limited nature, and confined to the objects specified in these clauses; and that in all other respects, and for all other purposes, the militia are subject to the control and government of the State authorities."

The justices of the Supreme Judicial Court of Massachusetts, in their opinion upon the subject say (80 Mass. Reports, page 614), that: "Were it otherwise, were the general and State governments to have their own militia, the results would have been that there would be, within the bosom of each State, a large embodied military force, not by its organization amenable to the laws, or subject to the orders of the State government; and also a similar force on which the general government would have no right to call for aid to repel invasions, suppress insurrections, or execute the laws; a state of things not only rendering each to a great extent inefficient and powerless, but also entirely destructive of that harmony and union which were intended to characterize the combined action of both governments."

The Constitution makes no provision for a "National Militia." The phrase is a solecism whenever applied to the militia of a particular State, whether called into the actual service of the United States or not.

The Constitution specifies distinctly the exclusive purposes for which the militia may be called into the service of the United States, that is, (1) to execute the laws of the Union; (2) to suppress insurrections; (3) to repel invasions. "These three occasions representing necessities of a strictly domestic character, plainly indicate that the services required of the militia can be rendered only upon the soil of the United States, or of its Territories. Under these circumstances they still remain the militia of their several States, although temporarily in the service of the United States as the superior power constitutionally invoked 'to execute the laws of the Union, to suppress

insurrections and to repel invasions.' \* \* \* And it is but just to infer that the enumeration of the specific occasions on which alone the militia can be called into service of the general government, was intended as a distinct limitation upon their employment. \* \* \* They cannot consequently be used to invade territory of a neighboring country or to enforce any public rights abroad. \* \* \* It was the hereditary fear of standing armies as a menace to liberty in time of peace which led the framers of the Constitution to provide that the militia should always remain a militia of the States. It was never designed to be a militia of the United States, nor under the control of the President, except when called into actual service under some of the above enumerated contingencies. Nor was he even then to be allowed to do so at his arbitrary pleasure, but only after the necessity for so doing had been recognized and approved by Congress." (Ordonaux's Constitutional Legislation, page 501-3.)

"The militia of the States restricted to domestic purposes alone, are to be distinguished therefore from the army proper of the United States, which, whether in the form of regular troops or volunteers, may be used to invade a foreign country as well as to repel the attack of foreign enemies. The invasion of Mexico in 1846, and of Canada during the war of 1812 with Great Britain, are notable instances of this kind. Although in the latter case some militia did participate in the battles of Chippewa and Niagara, on Canadian soil, a portion claimed their Constitutional rights and refused to cross the frontier. Guilty as they may have been of flagrant insubordination, it is doubtful whether any military court could have vindicated its jurisdiction in punishing this disobedience of an unlawful command." (Ibid, page 504.)

It is also well known that the State of Massachusetts in the war of 1812 denied the power of the President to order State militia to duty outside of the State, but this contention is not likely ever again to be maintained.

The power over the militia thus reserved to the States is so complete that a State may, unless restrained by its own Constitution, enact laws to prevent any body of men whatever, other than the regular organized volunteer militia of the State and the troops of the United States, from associating themselves together as a military company or organization, or to parade, or to drill with arms in any place within the State without the consent of the Governor of the State. (*Presser vs. Illinois*, 116 U. S. 252.)

In discussing the clause of the Constitution relating to the offenses by persons in the land or naval forces, or in the militia in actual service, Mr. Justice Miller, in his work on the Constitution, page 507, said: "As regards offenses committed by persons in the militia the exception was limited to those 'in actual service, in time of war, or public danger.' And this has relation to what I said to you the other evening as to the power of the President under the second section of the Second Article as the commander-in-chief of the militia of the several States, when called into actual service of the United States. The militia is spoken of in other parts of the Constitution, and always has reference to a body of citizens of the States, organized under State authority into military divisions, subject to officers appointed by the States, and which may be called into the service of the Federal Government on special occasions mentioned in the Constitution. Therefore, if a person who is a member of the militia is charged with a crime against the United States, he cannot be proceeded against without an indictment or presentment of a grand jury unless he be 'in the actual service of the United States,' and 'in time of war or public danger.'"

The State alone is authorized to provide officers of the militia, except the President as commander-in-chief, may, when the militia are in the actual service of the United States, command them, either through militia officers or regular army officers of appropriate rank. (*Houston vs. Moore*, 5 Wheaton, 20. *Mills vs. Martin*, 19 Johnson, 7.) Whenever the militia has entered into the service of the United States,

its authority over them is exclusive and supreme, within the limits, however, hereinbefore noted. The authority to decide whether the exigencies contemplated by the Constitution and the Act of Congress of 1795, have arisen, is exclusively vested in the President, and his decision is conclusive upon all other persons. (*Martin vs. Mott*, 12 Wheaton, 19.) And so the Governor of a State, under State Constitutions and laws, is vested with power to determine conclusively when the exigencies of the State, under those laws, require the employment of the militia. (*Chopin vs. Perry*, Washington, Sup. Ct. Law Rep. An. Vol. 15, p. 116.)

These principles must be strictly regarded in any scheme for reorganization of the militia, and the authorities to sustain them are cited for the reason that a serious misapprehension of the real status of the militia has appeared in several articles recently published in the JOURNAL. Indeed, one writer gravely asserted the proposition that the present organization of the militia of the States is unconstitutional; that the active militia comes within the prohibition of the second clause, Section 10, Article 1, of the Constitution of the United States, which withholds from a State the power to keep "troops" in time of peace. The Supreme Court of Illinois in *Dunne vs. People*, above quoted, has shown this objection to be without force. And in this relation, the opinion of Mr. Justice Story in *Houston vs. Moore*, may well be considered.

It is not within the purview of these remarks to discuss the war powers of the Federal Government under the clause authorizing Congress "to raise and support armies," nor whether the system of militia intended by the framers of our government is bad or good, but merely to emphasize the necessity of regarding the real nature of the militia force when we consider any scheme for its betterment. The question is not what should, but what may be done. Congress is given the power to provide for organizing, arming and disciplining the militia of each of the several States. This power is concurrent in the Federal and State Governments, it being understood that State legislation with respect to providing for the organizing, arming and disciplining of its militia must be not in conflict with, but subordinate to, the unlimited power of Congress over the subject of these purposes. When Congress has *provided for* the organizing, arming and disciplining of the militia of the several States, its rights and power ceases. Congress may also provide for the government of such part of the militia of the several States as may be called into the service of the United States in time of war or public danger to execute the laws of the Union, suppress insurrections, or repel invasions, this employment being limited within or to the borders of the Federal Republic. But the authority of training the militia according to the discipline prescribed by Congress, and the appointment of the officers, are "reserved" at all times "to the States respectively."

In a military point of view an army formed from such material could not under all circumstances be effective. A military man would say that what is needed is a combined regular and volunteer force which may be employed in proper cases, abroad and at home, an army which may be used to vindicate the rights of the nation anywhere in the world. The idea is correctly conveyed in the Cromwellian language of the pious Puritans who framed the Massachusetts Constitution: "The Governor of this Commonwealth \* \* \* shall have full power by himself or by any commander or other officer or officers \* \* \* for the special defense and safety of the Commonwealth, to assemble in martial array, and put in warlike posture the inhabitants thereof, and to lead and conduct them and with them to encounter, repel, resist, expel and pursue by force of arms, as well by sea as by land, within or without the limits of this Commonwealth; and also to kill, slay and destroy, if necessary, and conquer, by all fitting ways, enterprises, and means whatsoever, all and every such person and persons as shall, at any time hereafter, in a hostile manner, attempt or enterprise the destruction, invasion, detriment or annoyance of this Commonwealth," etc.

Captain Chester's essay may properly be considered as his solution of the query, "What is the army organization best adapted to a Republican form of government which will insure an effective force?" But there are many forms of Republican government, and an army or militia organization that might be perfected for the Republic of France, would be impossible for the United States or for Switzerland. Ours is a Federal Republic. We have what are known as "rigid" Constitutions, national and State; and to these all systems of military organization must strictly conform. The settled policy of the United States is to have a small standing army, and to rely in time of war upon volunteers and militia. As the militia can be employed only in a domestic way, and as, in time of peace, we can have only a small regular army and the militia as constituting the military forces of the United States, it results that the true theory of reorganization of the army and of the militia should be to increase the regular army so as to secure a safe and immediate resistance of any invasion possible to occur, and also promptly to act offensively anywhere on this Continent. Ample means should be provided by Congressional legislation for the organizing, arming and disciplining of the active militia, the organization of the active militia to conform as nearly as practicable with that of the regular army, so that the organized militia commands could, upon the call of the President, at once volunteer, as such, into, and during the existence of the war or particular exigency become a part of, the army of the United States. The patriotism of the State Guards may be safely relied upon to induce them at once upon the President's call to volunteer for such service as might be demanded. Some provision might be made for the organization of that mythical force which in this country exists only in contemplation of law and is spoken of as the "Militia of the Reserve." Reliance for real service must be placed upon the organized active militia.

Every one knows the present militia laws of the United States are in great measure obsolete, and contain many requirements so absurd that neither the State nor Federal governments affect to observe them. And yet, it should not be forgotten that the old law of 1792 must serve as a model for any new enactment on this subject. The carefully guarded rights of the States as exemplified in that act prove that it was drafted by persons familiar with the legal checks and balances of the organic law. It would not be difficult to re-cast the obsolete sections, modernize the formations, declare a proper system of inspection by officers of the regular army, and make adequate regulations as to responsibility for public property.

#### Major J. Van R. Hoff, Surgeon U. S. Army.

In reading Capt. Chester's admirable article "Organization of Militia Defense," which appeared in the *JOURNAL OF THE MILITARY SERVICE INSTITUTION*, September, 1892, it occurred to me that it might be well to give form and substance to the outline therein set forth, of the military sanitary requirements of such an organization. The brief statement that "every regiment should be provided with one ambulance and every battalion with four stretchers," hardly conveys to the average mind the same relative information as does "eighteen guns," or "four hundred sabres to a division," but so far as personnel is concerned it means, in effect, precisely the same thing.

Military sanitary organization has become a recognized entity, and has a clearly defined military status in all the great armies of the world; it is not alone a question of ambulances and stretchers, but of men, material, in fact everything that pertains to any other military organization. In every one of Capt. Chester's proposed corps actual experience has shown that not less than two battalions will be required to care for its sick and wounded. Are these men to be taken from its fighting effective? Experience says not, but rather that there shall be a regularly organized corps whose

duties pertain to the care of the sick and wounded, and whose training to this end is certainly quite as comprehensive and important as that of any other soldiers.

Accepting the proposed organization as the one best suited to the conditions assumed, and reducing it to the recognized fighting unit of our army,—the division,—let us consider what should be the sanitary organization for this unit.

The military division outlined in "Organization of Militia Defense" consists of three brigades of infantry, each of three regiments whose strength is of twelve hundred men respectively, in all ten thousand eight hundred men; three batteries of light artillery, three hundred men; and a squadron of cavalry, four hundred men; making the total fighting strength of the division eleven thousand five hundred men.

With each regiment there will be required three medical officers; two non-commissioned officers and eight privates of the hospital corps. With each squadron of cavalry, one medical officer; one non-commissioned officer and four privates of the hospital corps. With each battery of light artillery, one medical officer, and one private of the hospital corps. With each brigade, one brigade medical officer; one non-commissioned officer and one private of the hospital corps.

This however is not all. The practical test of war has taught that "any military body trusting for its medical efficiency to the regimental aid alone, must of necessity come to utter grief when the regiments have to move forward off the battle-field, and the sick and wounded must look for attention to other hands than those of their regimental comrades." To meet the requirements of this situation, which certainly is the rule, there should be a trained body of men, sanitary soldiers, whose sole function is to care for the wounded. This body constitutes the distinctive divisional sanitary organization; it is entirely non-regimental, and is commanded by the chief medical officer, under the division commander.

Its subdivisions are as follows:

One chief medical officer; one non-commissioned officer and one private hospital corps.

A bearer company of the Hospital Corps (litter bearers, etc.), numbering three medical officers; fourteen non-commissioned officers, one bugler and forty-seven privates—total sixty-five (65).

An ambulance company of the Hospital Corps (ambulance drivers, etc.) numbering three medical officers, twelve non-commissioned officers, one trumpeter, one artificer, two blacksmiths, one saddler, and fifty-five privates—total seventy-five (75).

A field hospital, the personnel of which consists of three medical officers; twelve non-commissioned and twenty-eight privates of the hospital corps—total forty-three (43); making the total strength of the regimental and divisional sanitary organization, for each division, forty-four (44) officers; sixty-one (61) non-commissioned officers and two hundred and nineteen (219) privates hospital corps.

The number of ambulances required by a command of the strength proposed by Capt. Chester for a division in active service is thirty-one (31), of "army" wagons seventeen (17), and "escort" wagons one (1), requiring fifty-four (54) horses and one hundred and six (106) mules. This estimate is exclusive of mounts for officers and non-commissioned officers, and animals for medicine wagons, water carts, field forge, etc., all of which would bring the total up to two hundred and seven (207) horses, and one hundred and eighteen (118) mules.

From the foregoing it will be seen that the requirements of the sixteen proposed corps, (forty-eight divisions) in sanitary personnel alone (including a medical director, one clerk and orderly, for each corps) is twenty-one hundred and sixty (2160) officers, and thirteen thousand five hundred and thirty-six (13,536) enlisted men. The number of wagons to be added to Captain Chester's estimate of transportation require-

ments, based upon the above, is a mere matter of multiplication; and the aggregate is sufficiently large to materially increase his figures.

I might add that owing to peculiar service conditions, the relative strength of the Hospital Corps in our army to-day, is considerably in excess of the foregoing estimate. It is however believed that the strength suggested will prove sufficient to meet the ordinary sanitary requirements of the proposed organization.

Charles S. Clark, Editor 7th Regiment Gazette.

The article by Captain Chester is, as a leading military journal says, a very able one. The subject is one in which thousands of men, not in the army, take a deep interest, and the manner in which Captain Chester has treated it, cannot fail to inspire us with a respect for his powers of argument and clear incisive style. But, unfortunately, he views his subject from the standpoint of one who, however great his experience in the army, has not had the recent and practical experience in the National Guard which teaches what it is possible to do by way of organizing militia, rather than what could or should be done.

The American citizen is in some respects a very peculiar individual. He has his idiosyncrasies, and one of them is his dislike to being called a "militiaman," to being classed as a "militiaman," or to being given to understand that it is his duty to render service, rather than his privilege. To the designation "militia" cling memories of the old "training days" with their absurd parades and attendant mob of drunken men; memories of incompetent "political" officers, and careless, untrained men. A scheme of enrollment and muster, similar in many respects to that suggested by Captain Chester was provided for in New York by the law of 1847, districts being placed in charge of the National Guard rather than in charge of election officers. The system had a fair trial, under the very best auspices, and proved a flat failure. All men of military age were enrolled, but only those who had nothing else to do attended the muster. Falstaff's ragged army was a German army in comparison with the motley array which was then dubbed "the militia." The theory that the "militia" could be enrolled, drilled, and organized, received a death-blow in New York from which it will never recover, and that the National Guard and militia cannot exist side by side, was proven, by that experience.

The people will not consent to having the militia galvanized into life by any law, and the sooner we reject the idea that they will, and take as a basis for the organization of an army of citizen soldiery the fact that such army must be an enlarged and expanded National Guard, directed and provided for by the nation rather than the States, the sooner will the problem of organization of militia defense be solved.

The American people are opposed, and always have been, to *forced* service, either in the militia or army. And to the average voter the knowledge that by going to the polls he would subject himself to enrollment by the inspectors of election would produce one of two results; either he would protest against subjecting himself to the possibility of being placed in the enrolled militia by the inspectors of a political party other than his own, or he would stay away from the polls altogether. There are hundreds of thousands of men in this country who never go to the polls, simply because they do not desire to get their names upon the tax-assessor's lists, or jury lists. How many more would neglect their duties as citizens if they knew that upon voting they would be enrolled? The enrollment in the manner suggested by Capt. Chester would be a failure, and the imposition of fines for failure to appear and be enrolled would meet with a storm of protest. The poor man has little enough now; to take from the little he has the amount of such a fine, would be met with protests such as no political party would be willing to encounter. The marshal for the collection of fines

would be considered, as he was in New York, as on a par with the exciseman in Scotland or North Carolina, or the rent-collector in Ireland. Militia service would therefore become something hated, dreaded, and unpopular to the last degree. The men enrolled would be mutinous, and utterly devoid of that willingness to learn and to do duty which characterizes the National Guard.

Voluntary service, on the other hand, has always been popular, for the reason that it is believed that he who of his own free will, without being forced to do so by any law, offers his services to his State or Government is doing something which ennobles him. Our laws and literature teem with recognitions of this idea, and there is hardly town or village which has not its monument to "the volunteer." This is the American idea: "It is noble to *volunteer* to fight and die for Fatherland." But when you put service on a plane with paying taxes and water rates, and drag a man into the "militia" against his will, you eliminate all the sentiment, all the patriotism, all the glory and pride of doing duty voluntarily and for no sordid reasons, which inspired the men at Homestead and Buffalo.

Why then should a new and unpopular force be organized, when an organized and popular force exists upon which the new national army may be readily built up? Were the National Guard nationalized, placed under the command of regular officers and put into direct communication with the War Department, to which the State Adjutant Generals should report; were it provided with artillery parks and wagon trains as Captain Chester suggests; were it given modern arms and equipments and a standard service uniform, what better foundation upon which to build could be desired?

How the National Guard might be increased to 275,000 men, and how it might be divided into battalions, regiments, brigades, divisions and corps, in precisely the manner suggested by Captain Chester, may be illustrated as follows: There are 12 regiments in Brooklyn and New York. Were these expanded into 12-company, 3-battalion regiments—something all desire should be done—each regiment would contain 1249 men and the 12 regiments would make four of the brigades described by Captain Chester. But something more might be done. Two full companies are discharged from each regiment annually, or in other words fully 210 men obtain a discharge each year. By holding these men in Reserve Battalions for two years, after their discharge from service in the active regiments, twelve battalions each of 420 men would be available. The service of men held in reserve should be limited to participation in field manoeuvres and encampment-work, and annual rifle practice. Their duties would not be onerous, and as a rule the reserves would be glad to keep up some connection with their old regiments.

Were this plan carried out we should have in this locality:

1. In the Active Regiments about 15,000 men;

2. In the Reserve Battalions about 5000 men;

a total of 20,000 men, all serving voluntarily, in the infantry alone.

A corresponding increase of the N. G. S. N. Y. would furnish us with 33,500 men. And if in all parts of the United States as great an increase were permitted, an army of 275,000 men would be provided.

What such an army would cost Uncle Sam, Maj. E. C. Brush once proved in an article in the *Century* magazine. The Government can give each man a complete outfit, pay him \$50.00 a year for drilling, and \$24.00 for a yearly tour of duty in camp (including subsistence) and yet only pay to each man \$457.83 for five years service, or a little more than \$90.00 per year. But the payment of \$50.00 per year by the Government is unnecessary; the States should be the paymasters so far as ordinary routine duty is concerned; and \$40.00 per year per man would furnish the guardsman with uniform, equipments, supply trains, camp equipage, munitions of war, subsistence and pay for

camp duty. An army of 275,000 would therefore, and should, cost the Government \$11,000,000 per annum, less than half of what our army costs. An appropriation of ten million dollars would cost each inhabitant of the United States about 17 cents a year. Is this trifling sum too much to pay for security and the maintenance of the National honor?

## II.

## "The Physical Training of the Enlisted Man."

By Bvt. Lieut.-Col. A. A. Woodhull, Surgeon U. S. A.

THE importance of Lieut. Harrison's subject is not only great but it is so self-evident that one almost should apologize for discussing it at all. A soldier not an athlete, as Samson without his locks, is "like any other man." The popular notion of a soldier is that of a man constantly at the highest physical development. It is very true that the general health and the latent power of our men are far above the average of the same number of civilians taken by chance; but what may be called the official superiority ceases at that point. There are individual athletes in the ranks, but they have become such under adverse conditions. "Let well enough alone" represents the actual, if not the expressed, principle of much minor official administration. There is a dread of initiative, an indisposition to do more than has been done. In the older political days, the Whig party was represented as the breeching in the harness of start, its province was to pull back. Fortunately there are no defined parties in our military organization, but in the military harness of to-day the breeching is very strong and well filled out. The officer who, not very long ago, forbade his captains taking their companies into the adjacent woods as skirmishers because the gravel parade was intended as a drill-ground, might not approve of gymnasia. One such discourager of enthusiasm can do a good deal toward developing professional mummies. Embalming with spices is not always required to make a mummy. If you enclose him in plenty of moral wraps he will be just as good for nothing. A healthy conservatism is as necessary as the force of gravitation, but the inertia or rest does not represent the most exalted attributes.

Nevertheless, as Lieut. Harrison points out, the apparatus and the organization for physical development are not elaborate. At a few posts something is done. At the recruiting depots there is some systematic instruction. All that is needed is more diffusion. Light gymnastics only is required and care that what at first is a pleasure is not forced into monotonous drudgery. Compared with those that go into the British line, our recruits are physical and intellectual giants; but the careful attention paid there to very moderate but effectual exercise with the simplest apparatus shows most admirably in the setting up, in positive physical development, and in alertness. The only requisites are a moderate room, moderate intelligence, with no appliance that cannot be carried off at the word of command, and a very limited out-door space for running and the passage of obstacles. As I know by observation, men unfamiliar with such work take it up with positive delight and by very easy grades are swiftly led to a plane far above their old level, and they look upon their gymnasium hours not as work in the disagreeable sense but as play, or at the least, as pleasure.

The difficulties in our way are lack of trained instructors, although these should easily be supplied from the ranks, but particularly lack of interest in officers whose attention has not been awakened. As there are so many ways of killing a dog besides hanging him, so it is easy to devise, unconsciously it may be, some new way of not doing what the central authorities may require. Small garrisons, much fatigue, and especially frittering away the official day by duties strung through all the hours, waste

energy and dampen enthusiasm. The work is so simple and so interesting that it may fairly be said to carry itself along when once begun. In order to begin it, an intelligent interest must first be awakened in those who have the authority.

**Major John Brooke, Surgeon U. S. Army.**

A short time ago the writer was present at an entertainment given in camp by the cadets of the U. S. Military Academy. A prominent feature of the occasion was an exhibition of the manual, given by two cadets. They stood facing each other, perhaps six feet apart, and first went through the more common motions of the manual, with marvellous rapidity, ending by exchanging pieces, throwing them to each other straight from the shoulder. The pieces seemed scarcely to touch the new hands before the cadets stood back to back, and the same motions were executed, followed by the wheel and exchange of pieces. Without a pause a series of more complicated motions were commenced. Every conceivable and intricate motion that could be communicated to a gun was executed, and with such rapidity that it was sometimes difficult to follow them with the eye; ending with the wheel and exchange, the pieces leaving the hands with such precision that it seemed almost as if due to the centrifugal force of the wheel. There was no word of command—there was no time for one—no indication of what was to follow. With a single exception every motion seemed absolutely perfect, and the two were as simultaneous as if produced by a single machine.

Sheer strength is not the muscular faculty most to be desired, either in the military service or elsewhere. Agility, rapid and harmonious muscular contraction; consentienity of the muscular sense with the senses of sight and hearing; these count far more in any station in life, except perhaps that of the merest drudge. In a dead lift many a country blacksmith could outdo the two cadets, and he might knock either of them out of time with a single blow of his fist. But in an open fight he would probably never deliver that blow. Either of them would worry the life out of him before he had the chance to get it in.

The whilom world's champion of the prize-ring, "the Napoleon of sluggers," has just been dethroned by a man of decidedly inferior muscular development and strength. So great was the difference between the men, so striking the contrast, so well-marked the types, that even the not over-aesthetic ring reporters spoke of them as Hercules and Apollo; and they accounted for the downfall of Hercules by the fact that Apollo "could land two blows to any other man's one, in swiftness of delivery." And the editor epitomized the moral when he said: "Speed is the point of difference in the effectiveness of men who think, and men who act." Hercules presumed too much on his muscle. He was better fitted to clean the Augean stables than to spar with "Gentleman" Jim.

One not infrequently sees a raw, untaught rider, or one who is incapable of being taught; strong, muscular, but lubberly; mounted on a horse that is vicious, or is made frantic by a jaw-breaking bit; the horse rearing until finally he loses his balance and goes over, aided by the rider pulling on the reins. The horse generally comes down on top, and the rider limps off the field, or is carried away to the hospital. In contrast is an incident which the writer heard related of General Sackett by an eyewitness. He was then an officer of cavalry, and several years younger than he was when, with May, he rode over the guns at Resaca de la Palma. At a review he was mounted on a horse that was vicious, and kept continually rearing. Becoming at length tired of the performance he slipped to the ground while the horse was up, pulled him over backward in a twinkling, and when the animal regained his feet, before he had time to shake himself, was in the saddle and had resumed his place almost before he was missed.

We are told that when a systematic course of physical instruction was adopted in Rodney's light battery,—“in every way, and in everything, more attention was paid to feats of agility and quickness than to mere feats of strength. No effort was made to develop simply muscle or to learn to lift heavy weights.”

Results—“At battery drill the evidences of benefit were numberless. Cannoneers mounted on their chests at all gaits with an ease and confidence that was remarkable. The drivers were free, reckless, unconscious riders, who thought nothing of their seats, but gave all their attention to driving. When the cannoneers were required to mount upon the off horses, no matter what the gait, they came flying into the saddles with a free, clear vault; and no one had to stop and ‘shin up a horse's leg,’ or to use the stirrup to get on. And all this was the result of the confidence attained from their gymnastic training, and nothing else.”

The importance of a more general and thorough system of physical instruction in the army is no doubt pretty thoroughly appreciated in all branches of the service. Lieut. Harrison's idea is the correct one, that “said instruction should be administered systematically, and under the direction of the War Department.” But to reach that much-to-be-desired consummation there will probably be required some years of time and a great deal of hammering.

It is rare to see a post of any considerable size at which there is not some room in which the enlisted men can give a minstrel show, or have a ball. Why not provide for the more important gymnasium? The architectural surroundings and aesthetic finish of the college gymnasias are only refinements, and can be dispensed with. But provide the clubs, the bars, the spring-boards, and the other necessary appliances. Let the instruction be systematic; let it be directed by a qualified instructor; and, above all, let it take the place of a company drill.

And the instruction should not be confined to the enlisted men. Skilled labor excepted, no enlisted man should be expected to do that which his company officers are unable to do; whether it is to make a pot of good soup, or to ride like a centaur. The Military Academy may safely be left to look after her own graduates in that direction, especially with the superb gymnasium now being finished; but there should be provision for a prescribed course for officers appointed from civil life, and for those promoted from the ranks who are still deficient in that direction.

At recruiting depots gymnasias should be made to serve a double purpose. There are not a few men who enlist with congenital physical imperfections which are difficult to detect in the single examination that is given the recruit.

More enlist with defects due to former injuries, especially in the vicinity of joints—severe contusions, sublimations, and sprains—which leave no deformity that is visible. These cases break down under a few months' drill or hard service. They fill for some time a place on the hospital records; are fed, clothed, lodged, nursed, paid for doing nothing, and after a time discharged, soon to appear on the rolls—not of fame. A rattling good course in the gymnasium would soon bring out the defects in these cases, when the men should be discharged at once.

One point in Lieut. Harrison's paper is but remotely connected with the subject of physical training, but it is nevertheless one of immense importance. He says: “the never-ending ‘fours right,’ and ‘fours left,’ has been the bane of the enlisted man's existence. Drill should have one object that should never be lost sight of—instruction. As soon as it ceases to be instructive it should cease altogether.”

What would we think of a business house which required its clerks every morning to take an hour's bout at the multiplication table?

## United Service Gazette, September 10, 1892.

After the close of the Franco-German war it was very generally admitted in Germany, both by soldiers and civilians, that the remarkable accomplishments of their armies during that war, especially their thorough discipline exhibited in the most cheerful and self-sacrificing manner, their skill in overcoming natural and artificial obstacles in the enemy's country, their courage and calmness in battle, the resolution with which they bore pain and privation, were in a large measure to be attributed to the gymnastic training of the rank and file. The lesson was not lost upon France, and great importance is now attached to the gymnasium as a factor in the attainment of military excellence. As in the English and German services, the course is divided into two distinct heads: one embraces all the *exercices propres à l'assouplissement*, which are intended for the bodily development of the individual man, and as such have not professional character; the other refers to the *exercices d'application*, and includes all the exercises which bear on the accomplishment of feats of a peculiarly military nature—that is, exercises which will best prepare the soldier to meet the demands likely to be made upon him in a campaign. In fact, every military Power in Europe now shows thorough appreciation of the importance of physical training in the education of the modern soldier.

In the United States during the past ten years there has been a marked move by the schools and colleges of the country and by the people generally in the direction of gymnastic and athletic training, resulting in a manifestly increased strength of physique, erectness of carriage, and manliness of bearing; but the army, which for manifest reasons should be the hearty coöperator, if not the leader in such a movement, has, we have the testimony of Lieut. George F. E. Harrison, 2d United States Artillery, as an authority for stating, supinely stood by, and done nothing. In a paper contributed by that officer to the JOURNAL of the United States Military Service Institution, he writes thus depreciatingly of the "enlisted man":—"The popular idea of a soldier is a man of commanding presence, erect stature, broad shoulders, strong, graceful, neat. Is that the picture that we, in reality, hold up to the admiring gaze of the citizen? Is not the average soldier, as he is casually met in the street, rather the very reverse? Is he not—to be candid with ourselves—in many instances a shiftless, untidy, slouchy-looking individual? And yet one of the apologies we construct for ourselves is the fact that the people have no pride in their soldiers, that they frown them down and make outcasts of them."

We know that the Americans have in the past proved themselves excellent soldiers, but Lieut. Harrison seems to think that there is much to be desired in the "enlisted man" of the present day; he points out that he is the best paid, best clothed and fed soldier in the world, and asks who would believe it to look at him? He considers that the blame rests entirely upon his countrymen's own shoulders; that the enlisted man does not look like a soldier simply because they do not make a soldier of him. Lieut. Harrison pleads, "Make a better man of him for having become a soldier and everything else will follow. Make of him a gymnast and an athlete, in the proper sense of those terms, and you will make a man who will of necessity take a pride in himself;" and pride, after all, must ever be the foundation of the ideal military structure.

We cannot doubt that so practical a nation as the American will, without much further loss of time, set themselves to work to remedy a defect so obvious in their military system. The set-up of the average British soldier is no doubt excellent; but his physique, we fear, hardly justifies the good opinion formed of it by Lieut. Harrison. That a vast improvement in this respect is, however, being effected under the system introduced by Col. Fox into our army is becoming evident. Could the authorities but be induced to superadd to the excellent appliances provided for insuring mus-

cular development the system of expanding the chest capacity so successfully practised by Dr. Hambledon as President of the Polytechnic Physical Development Society—as to which we some time since gave full particulars—we might feel every confidence that we had made all provision possible to ensure for our soldiers sound, vigorous, and active bodies.

Archibald Maclaren, author of the "Military System of Gymnastic Exercises," speaking of the training of a young recruit as it was until recently conducted, asks what did such a youth gain in drill and parade for the development of his latent resources? Not yet twenty, he was capable of receiving vast additions to his physical powers. What was there in his professional duties to supply the want?—so little in comparison with his great requirements and almost unlimited capacity for improvement, and that little so partially and so unequally administered that even its value was reduced. For he could not attend a parade, walk a rifle range, cross a barrack-yard, or ascend a barrack stair without giving employment to the muscles of his lower limbs, although such employment was altogether inadequate to produce their full development; but it was abundant in comparison to what the upper limbs received. These were condemned to languish, to remain relatively feeble, because they were kept without employment; and power is in direct relation to activity.

Speaking of his well-known experiments on the subject of physical education, and referring to a non-commissioned officer who under his training gained five inches in actual girth of chest, Mr. Maclaren pertinently asks, Who can tell the value of these five inches of chest—five inches of additional space for the heart and lungs to work in? There is no computing its value, no power of computing it at all, and before such an addition as this could be made to this part of the body, the whole frame must have a proportional gain. For the exercises of the system are addressed to the whole body equally, and before this addition could be made to the chest every spot and point of the frame must have been improved also—every organ within the body must have been proportionately strengthened. But the change most impressively evident in the men under training Mr. Maclaren declares to have been the change in bodily activity, dexterity, presence of mind, and endurance of fatigue—a change a hundredfold more impressive than anything a tape measure and weighing chair can reveal. It must be remembered in this connection that Dr. Hambleton's method increases the chest girth of even an athlete.

We hope that the authorities will not stop in the effort to perfect a work so well begun, for it is now thoroughly realized that, notwithstanding the introduction of gunpowder, the cultivation of the bodily powers is now, as it was in the days of ancient Greece and Rome, the first and most indispensable condition of success in war.

### III.

#### "The Power of Military Courts to Punish for Contempt."

Lieut. W. P. Evans, 19th U. S. Infantry.

IT seems to me that Captain Birkhimer\* does not squarely meet the issue that is raised by the present procedure of courts-martial with respect to disobedient civilian witnesses. If it has ever been seriously contended that courts-martial have, under existing laws, the power to punish for contempt, I have never known of any reasons advanced to support the contention. The question was asked "What remedy has a court-martial in case a witness refuses to answer questions which the court decides are proper for him to answer?" and the answer was a discussion of the

\*Page 758 of JOURNAL, No. 58.

powers of a court-martial to *punish for contempt*. It would seem that there can be no difference of opinion on this point. Captain Birkhimer's discussion of this question makes it clear enough. The 86th Art. of War does not confer the general power to *punish for contempt*, nor does any other statute seem to confer it. But is the commitment of a disobedient witness until he complies with the lawful and proper mandate of the court a *punishment for contempt*? Legal decisions seem to answer in the negative. When an offender is *punished for contempt* "sentence must be pronounced by the court \* \* \* and the confinement must \* \* \* be for a definite period." Is not the commitment of a disobedient witness until he signifies his willingness to comply with the mandates of the court a *compulsory process* within the meaning of Sec. 1202 R. S., just as is the writ of attachment under which a civilian witness may be seized, deprived of his liberty, and brought forcibly before a court? Why should one of these procedures be called a *punishment for contempt* more than the other? Why is it lawful to resort to one of these processes and not to the other? Neither process is referred to in the statute, Sec. 1202, but we interpret the statute as giving us the right to use the one and as denying us the right to use the other, and yet the terms of the statute are "to compel witnesses to appear and testify."

British decisions are of course important in construing such of our laws as have a common origin with their own, and in defining common-law powers; but Sec. 1202 was enacted to meet the necessities of our own peculiar condition, and with its interpretation it would seem that British decisions and British practice have nothing to do.

I do not see how this question can rest as it now stands. Either we go too far in resorting to any process at all, or we do not go far enough, and thus fall short of exercising the powers conferred upon us by law. Our position seems illogical in the extreme. One of these processes is of no use without the other. Our respect for the law-making power should forbid the conclusion that it intended to legislate an absurdity, unless the wording of the statute compels us to that opinion. Should we not rather seek an interpretation that is in harmony with the known purpose of Congress in the enactment of the law and not one that leads to the lame and impotent conclusion that Congress meant nothing at all?

#### IV.

### "Whistler's Graphic Tables of Fire."

Lieut. G. N. Whistler, 5th U. S. Artillery.

CAPTAIN CHESTER in his most complimentary article upon my graphic Tables of Fire\* has expressed unbounded surprise "at the sudden change in Whistler's jump curve a little short of 7". He further states that an explanation "is absolutely essential to perfect confidence in the descending branch of the curve."

The philosophy of "Jump" has been a subject of considerable study upon my part for some years back. I did not, however, intend to publish my views upon the subject until I had been enabled to verify my theories by a more extended series of experiments.

Captain Chester's demand for an explanation, and the consequent doubt thrown upon the value of my Table No. 6, is entitled to prompt attention.

The observed phenomenon is as follows: When a gun is fired the shot leaves the muzzle at a greater angle of inclination with the horizon, than that of the axis of the bore before the piece was discharged. The axis of the bore must therefore change its inclination with the horizon, during the travel of the shot in the bore. As this motion

\* Page 108 JOURNAL, No. 59.

is always upwards it has been given the name of "Jump." The analysis of this phenomenon is the subject I propose now to consider.

A very simple experiment, that of marking the trunnion, will demonstrate that the gun does not turn in the trunnion bed. This however could have been assumed, as it is impossible that a force acting in the direction of the axis of the bore, with the centre of gravity in the axis of the bore, could rotate the gun in the trunnion bed.

The idea sometimes advanced that Jump is due to the reaction or spring of the carriage, which has been compressed by the downward component of the recoil, is not satisfactory, as the shot is undoubtedly out of the muzzle before the reaction begins. We have therefore but one other solution of the problem. That is, that the force of the recoil being applied above the centre of gravity of the entire system,—gun, and carriage,—rotates the entire mass about some *point of rest*.

If we assume for the purpose of simplicity, that in the sea-coast carriage the top carriage merely slides back on the chassis during recoil and does not jump thereon, it is manifest that the point of rest must be the lower element of the rear traverse wheels in a front pintle carriage, and some point on the bolster of a centre pintle carriage.

Now the component of the force of recoil which rotates the gun and carriage about the point of rest, is a decreasing function of the angle of elevation of the gun, varying with the cosine of that angle. Therefore the rotating force decreases as the angle of elevation increases.

It must however be remembered, that the magnitude of the Jump, that is, the distance through which the centre of gravity of the entire mass is lifted by the recoil;—or what is more important to us, the height at which the force of the recoil will sustain the weight of the entire mass at any instant of time during the recoil;—is a function not only of the rotating force (that is, the horizontal component of the force of recoil) but also of the relative lengths of the two lever arms.

Now the power acts through a "lever arm," which is equal to the distance from the point of application to the point of rest, into a function of the angle of inclination of this line with the horizon. The weight acts through a "lever arm," which is equal to the distance from the centre of gravity of the entire mass, to the "point of rest;" into a function of the angle of inclination of this line with the horizon.

Now as the gun recoils, both the point of application of the powder and the centre of gravity change position. When we consider the fact that the chassis does not move backward, it is manifest that the point of application moves backward much more rapidly than the centre of gravity.

The "lever arm" of the power shortens much more rapidly than the lever arm of the weight. Therefore the power of the force of recoil to maintain the centre of gravity at a given height, decreases as the gun recoils.

It is, therefore, manifest that the force of recoil continues to *lift* the front end of the carriage so long as the top carriage does not move. As soon however as the inertia of the gun and top carriage is overcome and the recoil begins, the front end of the entire system begins to drop.

Now if the shot leaves the muzzle before the recoil begins, it can only be affected by the lift; and as the amount of lift in a given time must necessarily be a decreasing function of the angle of elevation, it would follow that the jump would decrease as the elevation increased. If however, the shot does not leave the muzzle until after the recoil has begun, the effect upon the projectile will be that due to the difference between the *lift* and *drop* of the front end of the carriage during the travel of the shot in the bore of the gun.

For a given gun, conditions of loading and muzzle velocity, the time of the travel

of the shot in the bore will be a constant, or may be so considered. For convenience I will call this the "time of departure."

It is manifest that the amount of lift which occurs before the recoil begins, varies directly with the force of recoil. Considering the horizontal component of the force of the discharge as a measure of the force of recoil, it is evident that the lift will vary directly with the cosine of the angle of elevation. The drop is a function of the velocity of recoil, after the top carriage begins to move. The velocity of recoil varies directly with the cosine of the angle of elevation minus the angle of inclination of the chassis rail; and is therefore also a decreasing function of the angle of elevation. The time required to overcome the inertia of the gun and top carriage increases with the angle of elevation, while the time of departure remains constant.

Taking these two facts into consideration it is manifest that the drop decreases more rapidly than the lift.

Now the jump is a function of the lift minus the drop; both of which are decreasing functions of the angle of elevation, but the drop decreasing more rapidly than the lift. Therefore so long as the time of departure exceeds the time required to overcome the inertia of gun and carriage, *the jump must be an increasing function of the angle of elevation.*

As the time of overcoming the inertia increases with the angle of elevation, and the time of departure remains constant, it is evident that the maximum jump must occur when these two times are equal; as after this the drop does not affect the shot, and the lift is a decreasing function of the angle of elevation. Therefore when the time of departure is less than the time required to overcome the inertia: *the jump is a decreasing function of the angle of elevation.*

Therefore a *jump curve* constructed as in Table No. 6 will begin with an ascending curve, which will continue to ascend until the angle of elevation is reached at which the time of departure of the shot and beginning of the recoil coincide; at which point the curve will reach a maximum. For an angle greater than this, the curve will descend.

There is therefore no incongruity in the "descending branch" of the jump curve of the 8-inch M. L. Rifle.

So far I have considered the top carriage as merely sliding back on the chassis. The jump of the top carriage complicates the question, and is undoubtedly the main cause of the observed lack of uniformity in the amount of jump.

I hope at some time in the future to be able to make some experiments looking to the solution of this problem.

In conclusion I would simply state that the jump curve in Table No. 6, can be relied on for the gun from which it was constructed, and I believe approximately for all 8-inch M. L. rifles.

#### V.

### "Journal Military Ser. Ins. No. 59."

Colonel T. M. Anderson, 14th U. S. Infantry.

UNLESS one, like Bacon, can take all knowledge for his province, he can only comment on the diverse articles of a Military Journal, from his own point of view. And in setting up for a critic it is necessary to avoid the combative bigotry of the ancient knights, who fought about the gold or silver sides of the shield, because neither saw the other side.

The object of our association, as I understand it, is to discuss all subjects which integrate with our profession with absolute impartiality.

The first subject treated in our September JOURNAL, was, "Terrain in Military Operations."

Certainly every one understands the term "Terrain," yet it is not an English word. It is not given in our standard dictionaries or in Wilhelm's military dictionary. The subject was given as the subject for last year's prize essay, and Lieutenant Reed defines the term clearly enough. Yet why use a word of obscure foreign derivation?

When I was a law student, my preceptor, a very eminent orator, used to give me his prepared speeches and tell me to cut out all polysyllables and foreign words. From this practice I found that very forcible arguments could be made in very simple Saxon.

As to the way the diversities of territory control strategy, and the inequalities of ground effect tactics, men have argued and differed time out of mind. It is essential that military men should study these questions. Yet books alone never made a good general, a good hunter, a good guide, or a good geologist. Nature cannot be learned at second hand. In the problem of war one must not only know the field of operations, but realize, not vaguely but vividly, the modifications of heat, cold, floods, mud, mist, fortifications and fighting.

A general must have a military imagination. He must see in his mind's eye his own tired columns struggling into place, and the lines of the enemy stretching through distant field and forest. This perception of possibilities is as important to the strategist as to the tactician.

There is a tradition, that when General Moreau was in this country, he was asked his opinion of Napoleon Bonaparte.

He is said to have answered: "I think I could hold my own against Bonaparte on a field of battle with troops equal in number and of about the same quality. But," he added, "if I were on the Potomac with a hundred thousand men and he on your Canada border with fifty thousand, and we had to fight for the intervening country, he would whip me to death."

Turning to another subject, I must say that the most interesting article to me in the last JOURNAL was Hohenlohe's monograph on the Infantry Brigade. We like to have our opinions confirmed by high authority. Now I have been asserting for many years, with what some may think "damnable iteration," that we have been laying too much stress on forms and too little on substance. That we have magnified organization, drill, scientific theory and the niceties of administration. Here we find Hohenlohe, after discussing in preceding letters the drill, discipline and instruction of all the different units of command, when he comes to that final aggregate, the Infantry Brigade, having almost nothing to say on these points or on methods of attack or defense; but takes for his text and preaches his sermon on the spirit that must be impressed on that arm of strength,—the Infantry. Pride of profession, Love of Country, Loyalty to King,—these are his watchwords. How much more should we endeavor to awaken such sentiments in our Army of the People, in our Government for the People.

Who does this? And how is it done? Do we swear our men to be true to their colors with impressive ceremonies? Do we celebrate our national holidays except with greased pigs and slippery poles? Do we talk to our men and stimulate and encourage them? Do we not all know officers who simply drill, feed, punish or reprove?

During the late rebellion our Government gave commissions in the army to many foreigners. This was thought advisable at the time, but experience has proved that we could have done better without them. We might have been spared the shame of seeing these soldiers of fortune claiming promotion because they represented a foreign element and controlled a foreign vote, thus showing in anticipation a military and political Cahenslyism.

Speaking solely for myself I would say that we should not enlist men in an army

unless they are native born or naturalized. Not that the foreigners may not be just as good, but that the important thing is, to place a premium on American citizenship and army service. It is our first and highest duty to impress on the American soldier that he is the best soldier in the world, that he serves the best Government and represents the noblest principle. We cannot do this if we accept a soldier as we buy a mule.

I do not believe that success will be won in the future "by the aggregate of individual intelligence and effort," but rather in the force of many units welded into mighty masses and directed by intelligent leaders.

It does not sound scientific, but I believe that we must put our trust in the force of attrition;—the power of blood and iron. The question is, can we get this catapult power with a militia organization? Hohenlohe incidentally explains his distrust. Yet in the JOURNAL under discussion we have the best article on Militia Defense which has yet appeared. Captain Chester's thesis is worked out with great care.

There was a time in the history of Rome when the citizens ceased to pay taxes and the State depended for support on contributions levied on conquered provinces. War was waged as a business and conquests made for profit. From that time the virtue of the Roman citizen declined. Then, as a natural consequence, the Roman soldier lost his vigor. The excellence of the American soldier depends upon the character of the American citizen. So long as we have good citizens, we will have no trouble in getting good soldiers, that is, unless we are to have an army of hirelings who will fail us because they are hirelings. Then why not depend on our citizen soldiery as a National Defense?

Here we have to deal with a plausible yet dangerous fallacy. What does it avail if the spirit *is* willing, if the flesh is weak? Something more is needed than temperance and zeal. Something that you cannot get in one month's training, in twelve, or even in a two years' enlistment. Not only a mechanical knowledge of the trade, but a habit of obedience and self-denial.

The old Berserker fierceness is a heritage of our race, but it is nearly lost in centuries of enervating influences. The steel in our blood must be tempered by the fire of action and the hammering of discipline.

Leaving generalities, I would say that the only way to infuse into the Militia a substantive character, is to link them with regular regiments. This system is being tried in Great Britain. The result there is said not to be very satisfactory, but the reason is evident. They emasculate their militia battalions by recruiting their regiments on foreign stations from them; thus reversing the Continental method of having officers and men go back from the line to their national reserves. Our army is too small even to lighten the mass, or I would suggest that we should localize our regiments and link them with militia battalions.

It is but fair to say that Capt. Chester's scheme is elaborated with marked ability. As auxiliary to a regular force, it is an admirable suggestion. He makes one statement, however, which I think is erroneous. It is, that it is not probable that more than 30,000 men could be brought to our shores at once. Either an affirmation or denial of this must be based on very uncertain statistics and conditions. Great Britain did ship an army of 31,000 men, with an unheard of amount of impedimenta, from England to Egypt, in three weeks, without using her troop-ships more than once. We shipped a corps of 25,000 men from the Chesapeake to the Rio Grande at one time, using about 55,000 tons of shipping or about two tons to each man. The usual calculation for sea transportation is one man to ten tons, this including a month's supplies of all kinds. The mercantile ocean steam tonnage of Europe in 1890 was thirteen million tons. If one-thirteenth part of this could be used at one time an army of one hundred thousand could be landed on our coast at one time. How often this

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could be repeated would be wild guessing, and it would be a waste of time to get up a "Battle of Dorking" discussion on this hypothesis.

I think that very few of our older officers could be induced to venture an opinion on our "Best Method of Defense." Their suggestions would probably not be popular. In the last resort conscription is the only reliable resource, and our house would have to be in flames before we would bring up that fire engine.

## Reprints and Translations.\*

### AERIAL NAVIGATION.†

BY O. CHANUTE, C. E., OF CHICAGO.

(By permission.)

UNTIL quite recent years, the possible solution of the last transportation problem remaining for man to evolve—that of sailing safely through the air—has been considered so nearly impracticable that the mere study of the subject was considered as an indication of lunacy.

And yet such measurable success has recently been achieved as to warrant good hopes for the future, and it is believed that speeds of 25 to 30 miles per hour, or enough to stem a wind less than a brisk gale, are even now in sight.

This is not unusual in the history of inventions. They are first proposed by the men of imagination, the poets and the dreamers, and next they are experimented upon by the more imaginative inventors, until at last some glimmer of success or some powerful incentive induces scientific men to investigate the principles, and ingenious inventors to endeavor to solve the problem.

Thus, if we are to believe ancient fable and history, desultory attempts to fly through the air followed close upon the invention of the land chariot and of the marine sail, but the mechanical difficulties in the way are so great that it is only since light primary motors have been evolved that any success at all has been achieved; and even now the students of the problem are divided into two camps or schools, each of which expects flight to be compassed by somewhat different apparatus. These are:

1. AERONAUTS, who believe that success is to come through some form of balloon, and that the apparatus must be lighter than the air which it displaces,

2. AVIATORS,‡ who point to the birds, believe that the apparatus must be heavier than the air, and hope for success by purely mechanical means.

Curiously enough, there seems to be very little concert of study between

\* Please address communications concerning reprints, translations and reviews to Lieut. J. C. Bush, editor of this department.

† A lecture delivered at Cornell University in 1890 and published by *The Railroad and Engineering Journal*, by whose courtesy the plates are furnished.

‡ From *avis*, a bird. This comparatively recent French term seems so appropriate as to warrant its adoption into English.

these two schools. Each believes the other so far wrong as to have no chance of ultimate success.

Their work will be described separately; and first that of the *Aeronauts*, in which it will be necessary to describe chiefly French achievements, that nation having taken the lead hitherto in studies aerial, probably in consequence of the invention of the balloon by Mongolfier in 1793.

#### AERONAUTS.

This great step (as it is believed to be) toward a possible solution of the problem at first excited the wildest hopes. Many believed the navigation of the air to be an accomplished fact. These hopes faded: it was soon found that an ordinary spherical balloon was at the sport of the wind; and all sorts of impracticable devices were tried to control its motions, save till quite recent years (1852) that of furnishing it with a screw and an energetic motor.

While it is possible to impart low velocities, in calm air, to any kind of a balloon, yet the motive power which it could lift has been so small, and the consequent speed so inferior to that of ordinary winds, that until 1884 no balloon had ever come back to its starting-point.

We can perhaps best realize this deficiency of motive power by calculating approximately the speed which can be imparted to a spherical balloon by the motor it is capable of lifting; and instead of selecting one of those generally employed in ascensions, of 30 or 40 ft. diameter, we will take as an illustration the great captive balloon built and operated by Giffard during the French Exposition of 1878, which was one of the largest and best ever built.

This was 118 ft. in diameter. Its volume was 882,925 cubic feet and its gross ascending power was 55,120 lbs. As the weight of the balloon proper, its car, appurtenances and fixtures was 30,536 lbs., there remained a net ascending power of 24,584 lbs., which might be utilized for a motor, its supplies, and a cargo.

Let us first calculate the resistance of the air to its motion.

Being a sphere 118 ft. in diameter, the area of its mid-section was 10,936 sq. ft. This would not, however, offer the same resistance as a flat surface, the experiments of Hutton and of Borda having shown that the resistance of a sphere is 41 per cent. of that of a flat surface of area equal to its mid-section.

But to this is to be added the surface of the car and rigging, as well as that of the motor, its framing and machinery conveying power to the propeller. This is generally found to be equal to about 1-10 the area of the balloon, and as the surfaces are mostly flat, the resistance is usually estimated at 50 per cent. that of a flat plane. Reducing these two factors to their equivalent flat feet, we have:

$$\text{For the balloon: } \frac{10,936 \times 41}{100} = 4,484 \text{ sq. ft.}$$

$$\text{For the car, etc.: } \frac{10,936 \times 50}{10 \times 100} = 546 \text{ " "}$$

$$\text{Total equivalent flat surface. . . . . } 5,030 \text{ sq. ft.}$$

We know by Smeaton's tables of air pressures that at a speed of 1 mile per hour the pressure upon a flat surface is 0.005 lb. per square foot, so that at this speed we may estimate the resistance of the balloon to be  $5030 \times 0.005 = 25.15$  lbs.—that is to say, that a force of but 25.15 lbs. continuously exerted would be sufficient to impart a speed of 1 mile per hour to this great mass in still air; and as this velocity is 88 ft. per minute, we have for the power required :

$$25.15 \times 88 = 2213.2 \text{ feet-lbs., or } 0.067 \text{ H. P.}$$

This seems small indeed, but as the power required increases as the cube of the speed, let us see how fast the balloon can be driven by any available motor.

The net ascending power is 24,584 lbs., but not more than half of this (as shown by the subsequent practice of Renard and Krebs) is available for the motor. The remainder is required for the framing, the propeller, the transmitting machinery, the stores of fuel or supplies and the aeronauts. We will assume therefore 12,584 lbs. for the weight of the motor proper, and that this weighs but 110 lbs. per H. P., as was the case with the steam-engine used by Giffard in his navigable balloon of 1852. The possible H. P. is therefore :

$$\frac{12,584}{110} = 114.4 \text{ H. P.}$$

If we suppose this to be exerted through an aerial screw, inasmuch as the best that has yet been publicly tried gives out but 70 per cent. of the power applied (the remainder being lost in slip), we shall have for the real available power  $\frac{114.4 \times 70}{100} = 80$  H. P. But as the resistance in still air requires an effective H. P. of 0.067 H. P. at 1 mile per hour, and the power required increases as the cube of the speed, we have

$$0.067 v^3 = 80; v = \sqrt[3]{\frac{80}{0.067}} = 10.6 \text{ miles per hour.}$$

as the utmost probable speed which could have been obtained with the most energetic motor which this great balloon could have taken up into the air.

How far this would fall short of stemming the prevailing winds will appear from the inspection of the following table, quoted by M. Gatendorf as the average velocities of wind observed during a period of ten years in Germany, there being during that time per annum :

82 days of wind not exceeding 11.18 miles per hour.						
244½	"	"	"	"	"	22.37 " " "
38	"	"	"	"	"	42.50 " " "
½	"	"	"	"	"	89.48 " " "

So that the occasions would indeed have been few upon which this air-ship could have made any headway; yet had its possible speed been 25 miles per hour, it might have gone out about three-quarters of the days in the year ;

but in order to attain this speed it would have required a motor of nearly 1500 H. P., which evidently it was quite impossible for it to lift.

Moreover, the recorded wind velocities are generally observed near the surface of the ground; but at comparatively moderate altitudes, say 1000 to 1500 ft. above the earth, they are much greater. Records kept at the top of the Eiffel Tower for 101 days (June to October, 1889) show an average velocity of 15.75 miles per hour, while a similar instrument 925 ft. lower down registered during the same time an average speed of but 4.90 miles per hour, or less than one-third of that at the top, 994 ft. in the air.

It is probably for lack of a realizing knowledge of this peculiarity that so many past experiments with navigable balloons have proved such disappointments. The aeronauts measured the speed of the wind at the surface, and only went up into the air to be swept away by a swifter current.

In view of the fact that wind velocities are much greater at sailing heights than at the surface of the ground, the opinion may be expressed that aerial navigation cannot be accounted even a partial success until a velocity of 30 miles per hour is obtained; but in order to remain well within the bounds of possibilities, the comparison hereafter to be made will be based upon a speed of 25 miles per hour.

This brings us naturally to inquire as to what has thus far been done. It is clear that nothing was to be expected from any attempt to drive spherical balloons; that the resistance must be diminished in some way; and yet it took 79 years for aeronauts to realize the fact: for although General Meusnier had proposed them, and Robert Brothers had experimented with elongated balloons as early as 1784, it was not until 1852 that Henri Giffard, the future inventor of the injector, laid down the foundation for eventual success by ascending with a spindle-shaped air-ship driven by a steam-engine.

#### GIFFARD'S BALLOON OF 1852.

On September 24, 1852, Giffard, then a young engineer 27 years of age, ascended from Paris in an elongated balloon filled with ordinary coal gas, driven by an aerial screw propeller actuated by a steam-engine of his own designing. He was at that time quite poor; but having been possessed since the age of 18 with the conviction that success was possible, he had communicated his enthusiasm to two of his college friends, who possessed limited means, and the three had contrived, amid many discouraging difficulties, to build and equip this first navigable balloon.

It was in shape a symmetrical spindle, 144 ft. long and 39 ft. in diameter. The screw was three bladed and 11 ft. in diameter. The steam-engine was of 3 H. P., and weighed with the *empty* boiler 330 lbs., or 110 lbs., per H. P. In proportion to its power, this engine was much lighter than any previously built; but it was the utmost weight of motor which the balloon could lift, after making due allowance for the weight of the apparatus, its appurtenances, the aeronaut, the fuel and the water. For the two latter 678 lbs. were allowed, of which 132 lbs. were in the boiler. Coke was employed as fuel, and the danger of setting on fire or exploding the gas escaping from the balloon was guarded against by surrounding the grate with a tight ash-pan, which again was surrounded with a vertical flue sheet. Thus no flame came

into contact with the outer air, and the products of combustion, cooled in the return flue, were projected downward through an inverted smoke pipe, into which the steam from the cylinder was exhausted.

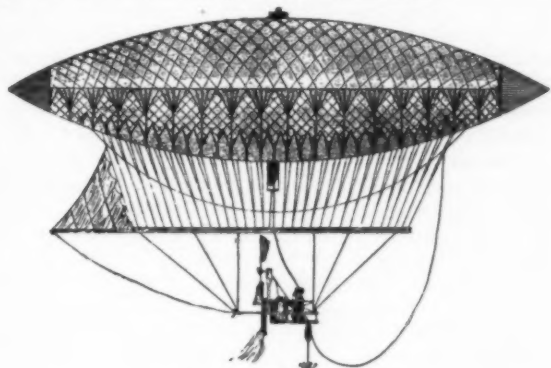


FIG. 1.

The cubic contents of the air ship were about 88,300 cub. ft., and being inflated with coal gas, its lifting power was 3978 lbs. Had pure hydrogen been used instead, the lifting power would have been about 6160 lbs., and a heavier motor could have been used; but this would have made little practical difference in the results as to speed. Fig. 1, is a side view of the entire apparatus. The surplus lifting power being only sufficient to carry up one man, Giffard went up alone, at about 5.15 in the evening. The wind on the day previously selected for the ascension blew with considerable force, and Giffard knew from his calculated resistances that he could not hope to stem it, but having attained an altitude of about 5000 ft., he set the engine in motion. With 110 revolutions of the screw per minute, he was enabled to get a proper speed of the apparatus, which he estimated at 4.27 to 6.70 miles per hour, so as to deflect and turn the balloon from the line of the wind; and thus, while satisfied that this first air ship was quite unable to cope with the wind that day or with those generally prevailing, he yet was enabled to announce his deliberate conclusion that ultimate success was certain with a large balloon and a more energetic motor.

He further expressed his belief, as a result of this experiment, "that the danger resulting from the juxtaposition of fire and an inflammable gas might prove to be quite illusory;" but yet no other aeronaut since his time has dared to repeat the experiment.

He came down in safety just after dark, though not without some danger. It was clear that in order further to reduce the resistance a still more elongated balloon would be required, and he resumed his studies and designs for further experiments with unimpaired enthusiasm; but the means of himself and friends were so far exhausted that it was only in 1855 that he was enabled to make a second trial with what he considered an improved apparatus.

This new balloon was 230 ft. long and 35 ft. in diameter, being thus 7 to

1 instead of  $3\frac{1}{2}$  to 1, as in the former experiment. This change, which was made to reduce the resistance, resulted in such longitudinal instability as nearly to cost Giffard his life. He was on this occasion enabled to take up a companion (M. Gabriel Yon) to assist in the manœuvres, but notwithstanding this, the balloon would not keep a level keel. The wind blew, and although he attained a greater speed than on the former occasion, he was unable to stem the current for more than a few minutes at a time, with all the power of his engine. One end of the balloon tipped up, and the flow of the gas toward that end aggravated the evil. The valve was at once opened, and the aeronauts came down as rapidly as they could; but just as the ground was struck with considerable violence, the gas bag, tipping up more and more, slipped out of the netting and went to pieces.

This accident did not alter Giffard's conviction of ultimate success, but he determined first to make a fortune. He shortly thereafter invented the injector and eventually became a millionaire, while at no time did he abandon his aeronautical studies.

In order to work out practically all the details as to gas-tight envelopes, stability, appliances, manufacture of hydrogen, etc., he built in 1867 the great captive balloon for the Paris Exposition of that year. In 1868 he built one in London, and again in 1878 he carried out further improvements in a new captive balloon at the Paris Exposition, this being the one which has already been alluded to.

At length, in 1881, he determined upon the construction of a gigantic air ship, to contain 1,766,000 cub. ft. of hydrogen and to cost \$200,000, out of which he expected a speed of nearly 45 miles per hour; but he was near the end of his career. First his health failed, and then his eyesight; he became a recluse; and finally, discouraged and maddened by physical pain, he died by inhaling chloroform in April, 1882.

Giffard was thus the first to drive a balloon with a motor, and this he did with a steam-engine. It is probable that men before now have gone into a powder magazine with a lighted torch and have come out in safety; still the practice is not to be commended. So Giffard went up with a lighted steam-furnace under a gas bag open to the air through its lower valve and he came down safely not once only, but twice; and yet other aeronauts believe the practice so dangerous that not one thus far has repeated the experiment.

#### THE DUPUY DE LÔME BALLOON, 1872.

During the siege of Paris, in 1870, some 65 ordinary balloons left the beleaguered city, but notwithstanding many efforts, not one of them succeeded in getting back. The Government decided in October upon building a navigable balloon, to restore communications, and entrusted its construction to M. Dupuy de Lôme, Chief Naval Constructor, to whose skill was largely due the success of the earlier armored ships of France. He went most carefully into the questions of balloon resistances, stability and working details, and pushed the construction as fast as the disorganized industry of the city would permit; but nevertheless the apparatus was completed only a few days before the capitulation.

Then came the insurrection of the "Commune," so that it was only on February 2, 1872, that the merits of the air ship could be tested.

The balloon was also a symmetrical spindle,  $118\frac{1}{2}$  ft. long and  $48\frac{3}{4}$  ft. in diameter (2.43 to 1). It contained 120,088 cub. ft. of pure hydrogen, and its lifting power was 8358 lbs. Its principal features of novelty were a system of triangular suspension, by which all weights were concentrated at a single point a short distance above the car, and the introduction inside of the gas bag of an air pocket or bag, say one-tenth in cubic displacement of that of the balloon, so as to keep it distended and rigid at all times, by blowing in or letting out air. This valuable device was found to remove, for low velocities at least, the danger of deformation from end thrusts or resistance of the air. We shall find it used again in the Renard and Krebs experiments of 1884-85. Fig. 2 is a side view of this air ship.



FIG. 2.

Dupuy de Lôme's ultimate purpose was that his balloon should be driven with an engine of some sort; but from a wholesome dread of fire, he tried his experiment with hand power. The total crew consisted of 14 men, of whom 8 laborers turned a winch, imparting  $27\frac{1}{2}$  revolutions per minute to a two-armed aerial screw  $29\frac{1}{2}$  ft. in diameter. This drove the apparatus at a speed estimated at 6.26 miles per hour, with an expenditure of say 0.8 H. P. It is believed that the speed was overestimated, but in any event it proved insufficient to stem the wind on the day of the trial. Dupuy de Lôme estimated that by substituting a steam-engine of 8 H. P., representing the weight of 7 men, or say 1200 lbs., he could obtain a speed of  $13\frac{1}{2}$  miles per hour; but the experiment was not made, and the next in date was

#### THE TISSANDIER ELECTRICAL BALLOON, 1883.

Impressed with the belief that recent improvements in electrical engines afforded a safe and convenient motor for balloons, M. Gaston Tissandier, the distinguished author and aeronaut, constructed in 1883, with the coop-

eration of his brother, a navigable balloon 92 ft. long and 30 ft. in diameter (3.04 to 1), inflated with 37,439 cub. ft. of hydrogen, and with a lifting power of 2728 lbs.

The netting in this case was formed of flat ribbons sewed to longitudinal gores, which arrangement was found materially to diminish the air resistance due to the ordinary twine netting. The apparatus was driven by a Siemens dynamo weighing 99 lbs., actuated by a primary battery (bichromate of potash) weighing 517 lbs. more and capable of developing  $1\frac{1}{2}$  H. P. for  $2\frac{1}{4}$  hours. The screw was 9.18 ft. in diameter, with two arms, and was rotated at 180 revolutions per minute. Fig. 3 shows this apparatus.

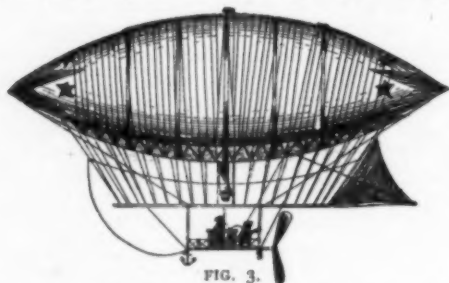


FIG. 3.

Two ascensions were made. The first was on October 8, 1883. On this occasion there was almost no wind at the surface, but at a height of 1600 ft. it was blowing at the rate of about 6.7 miles per hour. It was found that the apparatus was just able to stem it, exerting the full power of the motor. After performing various evolutions the aeronauts came down, intending to go up again the next day; but the weather being cool, the bichromate solution froze during the night, and although the balloon had apparently lost no gas, it was decided to empty it and to try it again after making some modifications in the rudder, which had not been found to work well.

The second ascension took place September 26, 1884, and on this occasion the balloon was found to obey its helm perfectly, to perform various evolutions and to attain a speed which, although inferior to that of the wind that day, was estimated by M. Tissandier at 9 miles per hour. This probably was also an overestimate. The longitudinal stability was satisfactory, and the necessary endwise rigidity was secured by maintaining an internal compression in the gas bag by means of a safety valve.

In neither trial could the air ship return to its starting point because of the wind, and the results were so far inferior to those obtained at about the same time by the French War Department, that these costly experiments, which had been carried out at private expense, chiefly in the interest of science, by two gentlemen of limited means, were not prosecuted further. They had pointed out the way, and established that by the substitution for steam of electric power, the following advantages were gained:

1. All danger from firing the gas was avoided.
2. The apparatus did not vary in weight.
3. The motor was more easily managed.

Others stepped in with abundant backing to carry on the evolution of the problem.

FRENCH WAR BALLOON, 1884-1885.

The aeronautical establishment of the French War Department, at Calais, was reorganized in 1879. There had been a similar establishment under the first French Republic, which had rendered some service by observing the enemy from captive balloons, but it had been disbanded. The new organization, which was chiefly intended to manufacture and man captive balloons, was in charge of able men, who had sufficient means to experiment, and the advantage of knowing all that had been accomplished by their predecessors. Giffard had pointed out the path, Dupuy de Lôme had gone into the mathematics of the question in an elaborate memoir, and Tissandier had exhibited the advantages of electric motors. The French officers in charge, Messrs. Renard and Krebs, improved very greatly upon all previous practice, and built, in 1884, an elongated balloon 165 ft. long by  $27\frac{1}{2}$  ft. in diameter, in which the largest section was no longer placed midway of the spindle, as in all previous attempts, but toward its front end, as obtains in the case of birds and fishes. Moreover, they placed the screw in front instead of behind, as previously practised; but the great improvement consisted in largely increasing the energy of the motor in proportion to its weight. Besides this, they obtained stability and stiffness by the use of an internal air bag and a better mode of suspension, and they enclosed the whole apparatus in a shed, so that it might be kept permanently inflated and await calm days for experiment.

This air-ship, which was named *La France*, held 65,836 cubic ft. of hydrogen, and its lifting power was 4402 lbs. The car was very long (105 ft.) in order to equalize the weight over the balloon, and yet admit of both being placed close together, in order to bring the propelling arrangements as near the centre line of gravity as possible. The screw was placed on the car; it was with two arms, and 23 ft. in diameter. The power of the motor was ascertained by experiment in the shop to amount to 9 H. P., and speeds of 17 to 20 miles per hour were expected with 46 revolutions of the screw. Fig. 4 represents this air-ship.

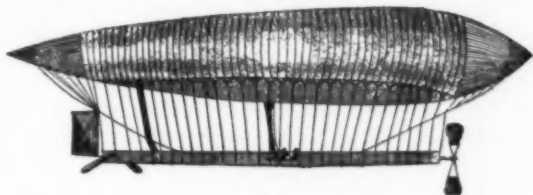


FIG. 4.

The first trial was made on August 9, 1884, and on a calm afternoon the balloon ascended, proceeded some  $2\frac{1}{2}$  miles from the shed, and returned to its original starting-point, having proved perfectly manageable, and attained a speed of  $10\frac{1}{2}$  miles per hour. This was the first time that a navigable balloon had returned to its landing, and the experiment attracted great attention, an account of it being, a few days thereafter, presented to the

French Academy of Sciences. The aeronauts believed they could make still greater speed, but for obvious reasons they jealously guarded such details of construction as were not apparent from casual inspection in the air, and more particularly the construction of their motor and battery, concerning which more will be said hereafter.

A second ascension was made on September 12, 1884 (14 days before the last ascension of Tissandier), but although a speed of over 12 miles per hour was attained, an accident to the machine (heating of journals) compelled landing at Velizy, instead of returning to the starting-point. The latter was, however, successfully accomplished again, November 8th following, when two ascensions were made on the same day, and a speed obtained of 13.42 miles per hour.

Various minor improvements were made in the apparatus, and in the ensuing year three more trial trips were taken, making seven in all, on five of which the balloon returned to its starting-point, as follows:

SCHEDULE OF TRIAL TRIPS OF "LA FRANCE."

No. of Trial.	Date.	Rev. of Screw.	Speed, Miles per hour.	Remarks.
1	August 9, 1884....	42	10.24	Returned to Chalais.
2	September 12, 1884.	50	12.19	Accident—descent at Velizy.
3	November 8, 1884..	55	13.42	Returned to Chalais.
4	November 8, 1884..	35	8.54	" " "
5	August 25, 1885....	55	13.42	High wind; descent at Villacoubray.
6	September 22, 1885.	55	13.42	Returned to Chalais.
7	September 23, 1885.	57	14.00	" " "

From these experiments, which, it must be remembered, were tried merely to test the efficiency out of doors of a new war engine, Captain Renard, while stating that the resistance was greater and the speed less than he had at first expected, deduced the following formulæ:

$$(1) \quad R = 0.01685 D^2 V^2$$

$$(2) \quad W = 0.01685 D^3 V^3$$

$$(3) \quad T = 0.0326 D V^3$$

in which

$R$  is the air resistance to motion in kilogrammes.

$V$  " " speed in metres per second.

$D$  " " diameter of the balloon.

$W$  " " work done in kilogrammetres.

$T$  " " " " on the shaft of the screw.

From this he calculated that a balloon 32.8 ft. in diameter would require  $43\frac{3}{8}$  H. P. to drive it at 23 miles per hour.

Since 1885 no outdoor experiments have been made so far as the public is aware, but it is understood that numerous experiments have been actively carried on within doors, which, being intended to improve a war engine, have been surrounded with profound mystery.

A year or so ago this policy of secrecy was apparently changed and

Commandant Renard began publishing a number of scientific papers upon various branches of the subject, such as the resistance of air, his experiments with aerial screws, the possibility of success with aeroplanes and the construction of his primary battery, which, after having been kept secret for a time, he now fully describes and figures, with the remark that "this publication now threatens no danger to the national security," from which it is not unreasonable to infer that he has found a more efficient motor, and that it is not electric; for he says further: "In the actual condition of industrial electricity, it is impossible that an electrical balloon shall constitute a true war engine."

At the Paris Exposition of 1889, the War Department erected a special building, and exhibited the air-ship *La France*, together with all its belongings, including the motor, battery, screw, etc., and full accounts of these exhibits have been published in various technical journals.

And yet the impression was produced on many minds while in Paris, more perhaps from what was not said than from what was shown and published, that the French War Department was, even now, in possession of important improvements and information which will afford increased speed, but which, as is right and proper, are kept secret to prevent their use by possible enemies.

Should this conjecture be correct, it is not impossible that, in case France should be involved in a European war, we should soon see navigable war balloons flying at the rate of 25 to 30 miles per hour, going out over the enemy's lines on reasonably calm days to observe his positions and to drop an occasional explosive on his head. Indeed, in some of his writings, Commandant Renard, after laying down that "the conquest of the air will be practically accomplished when a speed of 28 miles per hour is obtained," expresses the opinion that we are on the eve of freely navigating the air, and that probably France will possess the first aerial fleet.

It is stated that the German, Russian and Portuguese Governments have recently organized aeronautical establishments, and are experimenting in secret. Should some notable success follow, it will not be the first time that a great invention has been advanced by the necessities of war.

Leaving speculation, however, the table on next page gives the principal data as to the four air-ships which have been described, and the H. P. necessary to drive them at 25 miles per hour.

The last line shows how light a motor must be to produce 25 miles per hour without increasing the weight.

We will consider the all-important question of motive power after examining the probable requirements of apparatus heavier than the air.

#### POSSIBLE IMPROVEMENTS IN BALLOONS.

Before expressing an opinion upon the future speed of navigable balloons it may be interesting to review the various difficulties which have hitherto been met, and to inquire into what patent attorneys call "the state of the art."

The greatest speed thus far attained has been 14 miles per hour, which, as indicated at the beginning, is insufficient to cope with most of prevailing

## SCHEDULE OF NAVIGABLE BALLOONS.

DATA.	Giffard, 1852.	Dupuy de Lôme, 1872.	Tissan- dier, 1883.	Renard & Krebs, 1884-85.
Length, out to out.....ft.	144.3	118.47	91.84	165.21
Diameter, largest section....."	39.3	48.67	30.17	27.55
Length to diameter.... proportion	3.67 to 1	2.43	3.04	6
Cubic contents.....ft.	88,300	120,088	37,439	65,836
Ascending power.....lbs.	3,978	8,358	2,728	4,402
Weight—Balloon and valves .....	704	1,255.5	374	812
" Netting and bands....."	330	396	154	279
" Spars and adjuncts....."	660	1,316.5	75	170
" Rudder and screw....."	...	165	...	193
" Anchor and guide rope....."	176	308	110	...
" Car complete .....	924	1,287	220	995
" Motor in working order....."	462	2,000	616	1,174
" Aeronauts....."	154	310	330	308
" Ballast and supplies....."	567.6	1,320	849	471
" Total apparatus....."	3,977.6	8,358	2,728	4,402
H. P. of motor.....	3	0.8	1.5	9
Weight of Motor per H. P.....lbs.	154	2,500	410	130
Speed obtained.....miles per hour	6.71	6.26	6.71	14
H. P. required 25 miles per hour....	155	32(?)	77	51
Motor lbs. per H. P.....	3	38(?)	8	23

winds, particularly at sailing heights above the ground, and the following difficulties have been encountered and, to a certain extent, overcome.

1. Excessive loss of gas in early experiments.

This has been remedied by closer tissue of envelope and better varnishes, as well as by regulating valves, so that the loss of gas at the captive balloon in Paris last summer was said to average less than 2 per cent. per day.

2. Resistance of air to forward motion.

This has been largely diminished by pointed ends, but much remains to be done in ascertaining the best proportions.

3. Need of a propeller to act on the air.

This has been measurably solved by the aerial screw, which is said to exert from 50 to 70 per cent. of the power applied, but is yet less efficient than the marine screw, which works up to 84 per cent.

4. Need of steering gear.

This has been fairly worked out by various arrangements of rudders and keel cloths, which have given command of the apparatus when in motion.

5. Need of a light motor.

This is the great difficulty. Steam has been tried with a weight of 154 lbs. per H. P., including fuel and water, and electric engines with a weight of 130 lbs. per H. P. Neither are sufficiently light to give the necessary speed, except, as will be explained, for very large apparatus.

6. Need of endwise stiffness.

This has been remedied by compressing the gas inside the balloon, either through the use of a loaded safety valve or through the use of an internal air bag. As speed increases more will need be done in this direction, and this will require stronger and heavier envelopes for the gas bag.

7. Need to prevent deviations in course.

This has been overcome by placing the screw in front, where it is more effective than behind.

8. Need of longitudinal stability.

This has only been partly solved by various methods of suspension. There is still a tendency to pitch when meeting gusts of air, and this will increase when greater speeds are attained. It will need to be worked out by experiment.

9. Need of altitudinal stability.

This is the tendency of the balloon to rise or fall with the heating or cooling of the gas. It has been met in only a crude way by alternately discharging either gas, to prevent the balloon from bursting, or ballast, to prevent it from coming down. This rapidly exhausts both gas and ballast, and limits the time of the trip.

It has been repeatedly proposed to substitute for this method a vertical screw, to raise and depress the balloon, which should then be at starting slightly heavier than the air which it displaces; and one of the best proposals for this purpose is due to an American engineer, Mr. E. Falconnet, who patented it in 1885, together with many other features, to remedy the various difficulties which have been encountered; but death cut short his labors, and his devices have never been experimented on.

The great desideratum is to gain increased speed, and there are at least four ways by which this may be accomplished.

1. By giving the balloon a better form of hull, so as to diminish the resistance. *La France* was rather blunt in front, and there is reason to believe that by simply moving the largest section further back, increased speed will result.

2. By designing a more efficient aerial screw. Commandant Renard has been experimenting in this direction, and says there is a shape much better than others, and that this form cannot be departed from without getting very bad screws; falling, as he expresses it, into a veritable precipice on either side.

3. By devising a lighter motor, in proportion to its energy. This is the great field in which work remains to be done. It was announced in September, 1888, by a newspaper correspondent that Commandant Renard had built a motor weighing 1100 lbs. and developing 50 H. P., but since then nothing has been heard of it.

4. By simply building larger air-ships, for, inasmuch as their contents, and consequent lifting power, will increase as the cube of their dimensions, while their weight will, approximately, only increase as the square, the surplus lifting power will evidently increase with the size, and greater motive power in proportion can be used.

Let us suppose, for the sake of this argument, that no improvement whatever has been achieved in either of the first three ways which have

been mentioned, and inquire simply what would be the effect of doubling the dimensions of *La France*. The comparison will be approximately as follows:

PRINCIPAL DIMENSIONS,	<i>La France.</i>	Double Size.
Length, out to out .....	165	330
Diameter, largest section .....	27.5	55
Contents of gas..... cub. ft.	65,836	526,688
Lifting power..... lbs	4.402	35.216
Weight of apparatus.....	2.451	9.804
" Cargo and aeronauts .....	779	1,500
" Machinery .....	1,174	23,912

As the motor (dynamo and battery) of *La France* weighed 130 lbs. per H. P., we have for that of double the size  $\frac{23912}{130} = 182$  H. P. motor, and calculating the speed by the formula of Commandant Renard, and inserting the new diameter, 16.8 metres, we have:

$$T = 0.0326 \times 16.8^3 \times V^3 \text{ in kilogrammetres.}$$

But as we have 182 H. P., and there are 75 kilogrammetres in the H. P., we have further:

$$182 \times 75 = 0.0326 \times 16.8^3 \times V^3,$$

$$\text{whence } V = \sqrt[3]{\frac{13650}{9.2}} = 11.2 \text{ metres.}$$

So that we see that the speed of the new air-ship will be 11.20 metres, or 36.7 ft. per second, say 25 miles per hour.

The same result is arrived at by considering that the new balloon will require four times the motive power of *La France* to go at the same speed, and that the power required increases as the cube of the speed. So that we see that a speed of 25 miles per hour is even now in sight, without any other improvement than doubling the size of the balloon.

It will not be safe to assume, however, that increased speed can be indefinitely obtained with mere increase of size, because with more speed a series of new difficulties are likely to arise, and some of the old ones to be aggravated.

The first of these will probably come from the lack of longitudinal stiffness. Although it has been found that a certain amount of internal gas pressure gives the elongated balloon sufficient rigidity to resist the pressures due to low speeds, so soon as these are increased there may be a tendency to buckle, twist and collapse, and this means more pressure, a stronger envelope and more weight; or a rigid internal frame, as proposed by Mr. Falconnet; and this also means much more weight.

Next, there will be in great balloons much greater difficulty in distributing equally the weight of the car and its contained motor over the gas-bag, because of the necessary greater concentration of weight in the car. It will

besides be found more difficult to apply the propelling power near the line of equilibrium, so as to avoid oscillations.

There will also be increased difficulty from the flow of the gas back and forth inside of the elongated balloon, thus displacing its centre of gravity, and threatening the danger which so nearly proved fatal to Giffard. Moreover, even slight changes of outer temperature, heating and cooling the gas in the balloon, and thus changing its ascending power, are likely to be far more troublesome when operating on large than on small masses of gas, so that it seems likely that large balloons will be found more unstable, both vertically and longitudinally, than the comparatively moderate sizes which have so far been experimented upon.

These difficulties can all be surmounted, no doubt, including the remaining one that large balloons will be costly, and that few can afford to experiment with them; but the various appliances necessary for stability will involve more weight and this again will require more size.

Be this as it may, it is evident that somewhere a limit will be reached beyond which unmanageable sizes will be met with. The weight, the size, the resistance will increase, as well as the speed, and somewhere there will be impracticability. We have seen that to go 25 miles per hour, and thus brave the wind about three-quarters of the time, we need an elongated balloon similar in shape to *La France*, 330 ft. long and 55 ft. in diameter. It is probable that, by improvement in the first three ways which have been mentioned, it may attain a speed of 30 or 35 miles per hour; but when it is attempted to obtain 40 miles per hour out of it, it will grow to lengths of say, 1000 ft. or as long as four ordinary city blocks, and diameters of 150 ft., or the height of an ordinary church steeple.

These seem unmanageable and impracticable sizes for ordinary uses. They are greater than those of ocean steamers, because the speed required is greater, to overcome the aerial currents; and the care and maintenance of these great air-ships will be a difficult matter.

It seems, likely, therefore, that in the near future elongated balloons will be built which will be driven at 25 or 30 or a few more miles per hour, which will be able to sail about on all but stormy days; but the cargoes carried in proportion to the size will be small, and to obtain speeds similar to those of express trains some other form of apparatus will have to be sought for.

(To be continued.)

## THE FIELD GUN OF THE FUTURE. \*

(Apropos of the recent work by General Wille.†)

By GASTON MOCH, CAPITAINE D'ARTILLERIE.

Translated by CAPTAIN FREDERICK A. MAHAN, Corps of Engineers.

## III.—Application of the preceding consideration to three existing guns.

**I**N order to leave the vague land of generalities, examples will be taken from existing guns, and not from among projects which have yet to see the light.

To this end, comparison will be made between the French 80-mm. (3.15-in.) gun, model of 1877, the English 12-pdr. (3-in.) gun, model of 1884, and the Spanish 8-cm. (3.15-in.) gun of the Sotomayor system. The reason for this choice is that, in spite of their rather low position in the scale of calibres, these three guns have the advantage in living force (initial and remaining) and effectiveness, over all the 9-cm. (3.54-in.) European guns, except be it understood, our own of 90-mm. (3.54-in.) which is similar to the 80-mm. (3.15-in.) but more powerful. Where the English gun departs from the gun of 80-mm. (3.15-in.) it does so in the direction pointed out by General Wille‡. In the Sotomayor gun, the departures take place in both directions, but the most important are in the opposite direction. It will be seen whither that leads.

19.—The English gun may be considered as having but one projectile since its shell and shrapnel are of the same weight. To be sure there are two patterns of projectiles of each sort, one of cast-iron and one of steel, but they are of the same weight. The French gun has but one projectile, the grape-shot shell, which is regarded as the equivalent of the English shrapnel § in the following table:

	English gun.	French gun.	Excess of the French gun.	
			Absolute.	Per cent.
Calibre.....mm.	76.2	80	+ 3.8	+ 5.0
Weight of projectile.....kg.	5,680	6,280	+ 0.	+ 10.9
Sectional density.....g.	124.5	125.3	+ 0.8	+ 0.6
Initial velocity.....m.	524	465	— 59	— 11.3
Initial living force.....kgm.	79,430	69,210	— 10,220	— 12.9
Weight of the gun.....kg.	355	425	+ 70	+ 19.7
Effectiveness of the gun... kgm.	224	163	— 61	— 27.1

Metre=1.093 yds.

Kg.=2.2 lbs.

Kgm.=7.233 ft. lbs.

If General Wille's ideas were accepted there would be no hesitation in declaring the English gun much the better of the two. The calibre is a

\* Das Feldgeschütz der Zukunft par R. Wille, General-Major à la disposition. Berlin. R. Eisenschmidt, 1891.

† See the *Revue d'Artillerie*, October, 1891, vol. xxxix, p. 87.

‡ Small calibre and relatively great sectional density.

§ No account is taken, in what follows, of breaking or torpedo shells, as their nature and fire are little known.

trifle less; the projectile is proportionally heavier\*; the initial velocity and living force are greater; but above all, the gun is very much lighter, and its effectiveness is much greater.

There is nothing about which to hesitate between these two pieces; but that which must be proclaimed is the real superiority of the 80-mm. gun over the English one which it preceded by seven years. The following table shows what becomes of the superiority in initial velocity of the last named:

Distance.	Remaining velocity.		Excess of the French gun.	
	English gun.	French gun.	Absolute.	Per cent.
m.	m.	m.	m.	
0	524	465	— 59	— 11.3
1000	372	356	— 16	— 4.3
2000	294	303	+ 9	+ 3.0
3000	251	270	+ 19	+ 7.6
4000	218	249	+ 31	+ 14.2

Metre equals 1.093 yards.

It will doubtless be admitted that the power of a gun becomes interesting from a range of 2000 metres (2187.2 yds.) and upwards. Now, at this range, the 80-mm. (3.15-in.) gun is the better, having a remaining velocity of 303 metres (331.36 yds.) which again is greater than any of the European guns. The work of the Austrian Captain Schubert, from which we take the data relating to the fire of foreign guns, does not give anything beyond a range of 4000 metres (4374.4 yds.) It is interesting to add that the remaining velocities of the 80-mm. grape-shot shell, at 5000 (5468.0 yds.) 6000 and 7000 metres (7655.2 yds.) are respectively of 235-m. (257. yds.), 228-m. (249.3 yds.) and 227 metres (248.2 yds.). This last is greater than what remains in any European field projectile at 4000 metres (4374.4 yds.).

If now we wish to take into consideration the strength of the two guns against obstacles, it will be found in the following table:

Distance.	Remaining living force.		Difference.	
	English gun.	French gun.	Absolute.	Per cent.
m.	kgm.	kgm.	kgm.	
0	79,430	69,210	— 10,220	— 12.9
1000	40,033	40,570	+ 537	+ 1.3
2000	25,005	29,386	+ 4,381	+ 17.5
3000	18,184	23,334	+ 5,150	+ 28.3
4000	13,748	19,845	+ 6,097	+ 44.3

Metre equals 1.093 yards. Kg. equals 2.2 lbs. Kgm. equals 7.233 ft.-lbs.

\* The sectional density of the English gun while weaker in absolute value is in reality relatively great; reducing the density 125.3 of the 80-mm. grape-shell proportionally to the calibre, only 110.3 is found for a 76.2-mm. (3-in.) shell.

Here thanks to the slight advantage in weight of the 80-mm. shell, its superiority is greater and very soon declared.\*

In the matter of the efficaciousness of the two projectiles by themselves, it is of the same sort, but hard to compare numerically, their different arrangements being considered. The English shrapnel contains 177 bullets in a steel case. The grape-shot shell contains 120 bullets which, with the separators, give 162 regular fragments, to which must be added the base plate and the fragments of the burster.

20.—It has been seen that the 59 metres excess in the initial velocity of the English gun did not avail it much. But more than that, it really hurts it greatly.

Having greater velocity and greater initial living force for less weight, the gun causes greater wear and tear on its carriage, which has necessarily been made appreciably heavier by the addition of a recoil check and stronger wheels. While the 80-mm. carriage weighs, without accessories, 500 kg. (1102 lbs.) that of the 12-pdr., far from being lighter, weighs 572 kg.† (1261 lbs.). In like manner the English limber is heavier than ours. A part of the excess is useful, as it carries 6 rounds more, which alone weigh about 50 kilogrammes (110 lbs.), without considering the corresponding additional weight of the chest. But, in order to insure interchangeability, it must have the same wheels as the carriage, and each wheel weighs 30 kg. (66 lbs.) more than those of the 80-mm. gun. In other words the English limber weighs, empty, 554 kg. (1221 lbs.) as against 420 (926 lbs.) and loaded, 920 kg. (2026 lbs.) as against 640 (1411 lbs.). It is true that a great part of this excess comes from the limber being overloaded, on account of the small number of caissons of the English battery, which has only six of these vehicles. But, in the end, one fact stands out prominently: while carrying, it is true, 6 extra rounds, the English piece weighs, complete, 1872 kg. (4127 lbs.) as against the 1595 (3516 lbs.) of the 80-mm. gun. Or, as a final result, a less powerful gun in every respect weighs complete with limber and carriage nearly 300 kg. (661 lbs.) more!

It is essential to notice that the comparison here made is only between pieces of 8c. (3.15 in.) as such, and nothing is said about their tactical use. If the devotion of the 12-pdr. gun to mounted batteries be considered, there is found, naturally, a certain advantage in weight over the 90-mm. (3.54-in.) gun, as the English gun weighs, under these conditions, 1900 kg. (4189 lbs.) as against 2080 kg. (4586 yds.) but can this small difference be regarded as making up for the enormous inferiority in power of the 12-pdr. as compared with our mounted batteries? And yet it must be added that, pushing the search for mobility to the extreme at the expense of that for power, the English only carry 36 rounds in the body of the caisson, and only give 6 caissons to each battery, so that the supply for all their batteries is but 108 rounds per piece against 156 (80-mm. batteries) and 141 (90-mm. batteries).

\*We are aware that the shape of the English shrapnel, less elongated in front than ours, has something to do with the inferiority of its fire; but we have not at hand the necessary elements for determining the part which this cause plays in the result.

†In the mounted batteries this weight even reaches 620 kg. on account of the addition of the seats on the axle; but here only the horse battery carriage is under consideration, it being a piece comparable with our 80-mm. gun.

21.—Let us now turn to the Sotomayor gun. The weight of the shell and of the shrapnel are the same. We then find :

	Sotomayor gun.	Excess of the 80-mm. gun.	
		Absolute.	Per cent.
Calibre.....mm.	78.5	+ 1.5	+ 1.9
Weight of projectile.....kg.	6,300	— 0.020	— 0.3
Transverse density.....g.	130.2	— 4.9	— 4.0
Initial velocity.....m.	460	+ 5	+ 1.1
Initial living force.....kgm.	68,014	+ 1196	+ 0.3
Weight of piece.....kg	285	+ 140	+ 49.1
Effectiveness of the piece.....kgm. per kg.	242	— 79	— 32.6

Kg. equals 2.20 lbs. Kgm. equals 7.233 ft.-lbs. Metre equals 1.093 yds.

The weight of the projectile should be considered equal to that of the 80-mm. gun, which is given in many works as 6,300 kg. (13.88 lbs.) and has probably been stated in round numbers as for the Sotomayor shell. Of the three considered, the Spanish gun has, relatively, the heaviest projectile, its calibre being nearly the greatest; its velocity and initial living force are the least; it is much the lightest and has the greatest effectiveness.

This being the case, here are what the velocity and living force become when the projectile has once left the gun :

Distance.	Remaining velocity.			Remaining living force.		
	Value.	Excess of the 80-mm. gun.		Value.	Excess of the 80-mm. gun.	
		Absolute.	Per cent.		Absolute.	Per cent.
m.	m.	m.		kgm.	kgm.	
0	460	+ 5	+ 1.1	68014	+ 1196	+ 13.3
1000	371	— 15	— 4.0	44242	— 3672	— 8.3
2000	309	— 6	— 1.9	30691	— 1305	— 4.2
3000	266	+ 4	+ 1.5	22743	+ 591	+ 2.6
4000	235	+ 14	+ 5.9	17751	+ 2094	+ 12.4

Metre equals 1.093 yards. Kgm. equals 7.233 ft.-lbs. Kg. equals 2.20 lbs.

Here then, where the constructor has not set out merely to excel guns ante-dating his own in the mere matter of velocity, he has succeeded in producing a piece which is, in the matter of firing, certainly far superior to the English gun. It is the equivalent of the 80-mm. gun at ordinary fighting ranges but tends to become inferior at great distances.

But the indirect consequences of the relative lack of velocity are still more important. The Sotomayor carriage weighs, without accessories, 285 kg. (628 lbs.) as against 500 kg. (1102 lbs.), weight of the 80-mm. carriage; with the gun and accessories it weighs 608 (1340 lbs.) against 955

(2105 lbs.). Fault may be found with the weight of the limber, 647 kg. (1426 lbs.), empty, against 420 kg. (926 lbs.), which is certainly high, although this limber is arranged to carry 36 rounds, like the English. Still, in spite of that, the piece limbered up only weighs 1538 kg. (3391 lbs.) against 1595 kg. (3516 lbs.). Its mobility is then the same as that of the 80-mm. gun, with 6 extra rounds in the limber.

On the other hand the Spanish battery is arranged like the English and has only 108 rounds per piece as against 156. Here again, this inferiority follows not only from there being but 6 caissons, but also from the body of the latter only carrying 36 rounds, like the limbers; and even if the number of caissons were increased to 9 the ammunition supply would only be 144 rounds per piece.

To sum up: the weight of the projectile is the same as in the 80-mm. gun, with a less initial velocity; the ballistic power is about the same at ordinary fighting ranges; the mobility is the same; the ammunition supply is less.

If, in this final result, the influence of the gun be set apart from that of the carriages, we see that it would be easy to make up the ammunition supply; for this it would suffice to give 9 caissons to the battery and to arrange the carriages like ours; indeed, the limbers would be lightened, and the matériel would become more mobile than that of the 80-mm gun. With an 80-mm. limber the Sotomayor piece, limbered up, would only weigh 1248 kg. (2751 lbs.). Hence the inferiority of matériel is only due to the carriages; in the matter of the gun it is superior.

22.—The bringing out of the relative positions of the three matériels may be completed by extending the idea of effectiveness laid down in § 14. The pieces complete (limbers included) weigh: English gun, 1872 kg. (4127 lbs.); 80-mm. gun, 1595 kg. (3516 lbs.); Sotomayor gun, 1538 kg. (3391 lbs.); hence the *effectiveness of the pieces* limbered up is respectively equal to 42 kgm. (303.79 ft.-lbs.), 43 kgm. (311.02 ft.-lbs.), 44 kgm. (318.25 ft.-lbs.), values which are sensibly equal. But if the gun and the carriage with its accessories be alone considered weights of 943 kg. (2079 lbs.), 955 kg. (2105 lbs.) and 609 kg. (1343 lbs.) are found; and hence for the *effectiveness of the pieces in battery*: 84, 72 and 112 kgm. Finally if the initial living force be not considered, but only that remaining at fighting ranges, the three guns are finally arranged thus: Sotomayor, 80-mm., English.

Hence it may be rightly said that the initial velocity of 524 m. (573.04 yds.), given by the English gun, makes the effectiveness of 224 kgm. (1620.2 ft.-lbs.) hurtful; much better is that of 163 kgm. (1178.99 ft.-lbs.) of the 80-mm. gun, resulting from a velocity of only 465 m. (508.5 yds.). Finally the reduction of the velocity to 460 m. (503.06 yds.) gives the superiority to the Sotomayor gun, by allowing the effectiveness to be raised to 242 kgm. (1750.4 ft.-lbs.) while lightening the carriage as well as the gun.

The influence of the velocity and weight of the projectile is certainly well known. Nevertheless, no harm has been done by setting it forth at a time when many minds allow themselves to be led astray by velocities which are permissible only in ships guns, and who would demand them of the field gun.

IV.—*Determination of the Weight of the Projectile.*

23.—The starting point in a project for a gun is the determination of the weight of the projectile. But it is also the delicate point; here calculation gives way to the arbitrary. This element once determined the others are, if not demanded by the strength of the gun, at least narrowed within very close limits, between which discussion is comparatively easy. But so long as this first step remains to be taken—choosing the weight of the projectile—a halt may be made at values far removed from each other.

In this way even so great a weight as 12 kg. has been advocated, which can be defended with difficulty as the future field projectile.\* But, without going so far, it is very permissible to hesitate between the extreme values of the present projectiles, that is in round numbers between 5 kg. (11.02 lbs.) and 8 kg. (17.6 lbs.). The weight proposed by General Wille is 6.5 kg. (14.3 lbs.) the exact mean between these limits.

This datum, which is a matter of valuation, will not be discussed for the time being at least. The cause of the differences just pointed out is really that the authors of projects do not consider here anything but the effectiveness of their projectiles and do not attach sufficient importance to the influence which their weight exercises on the other elements of the system. Now this effectiveness is wholly relative; the 4c. shell which would be considered harmless to-day was very effective when compared with solid shot. On the other hand, it is certain that if a projectile seem sufficient, there are alongside of certain disadvantages great advantages in having it as light as possible, especially from the point of view of the ammunition supply.

If the one point urged be effectiveness, on which we shall not dwell otherwise here, the projectiles of 6.5 kg. (14.3 lbs.) may very well be sufficient. Still it is necessary for this that their interior arrangement be suitable in every way, which is a matter of long trials and many experiments; and on this point it may be foreseen that the calibre proposed by General Wille has many serious deceptions in store for him, as will be shown further on.

It will be seen moreover that, if the total effectiveness of which guns of the present day are possessed is to be utilized, this weight is rather low, inasmuch as it leads to exaggerating initial velocity. Be that as it may, the weight proposed by General Wille will be assumed for the time being.

24.—But the point which, it is believed, may be discussed is the line of argument by which the author is led to this value.

As is the case through the entire course of his project, he starts from the present condition of the German, English, Austrian, French, Italian and Russian artilleries. The average weight of their shells, the general says in substance, is 6.6 kg. (14.55 lbs.); that of their shrapnel is 7.1 kg. (15.652 lbs.) But a general tendency is noticed to make the weights of the two kinds of projectiles the same in order to facilitate their firing; this is actually done in England and is practically done in France, for the grape shell (*obus à mitraille*) may there be regarded as the only projectile, the breaking or torpedo shell being reserved for special cases. Now, the general average of

\*Especially in a work greatly taken to task by General Wille: *Die Bewegungs-Erscheinungen der Langgeschosse und deren Beziehungen zu den Eigenschaften des Feldgeschützes der Zukunft*, by Karl B. Bender, Darmstadt, 1888.

these weights, destined to be equalized sooner or later, is 6.9 kg. (15.2 lbs.) It may reasonably be assumed that industrial advances will allow of coming down a little and of establishing an effective projectile of 6.5 kg. (14.3 lbs.) weight.

Surely, averages are good. But they must be of quantities which are comparable with each other. What would be said of a project for a siege-gun of the future which rested on the consideration of the average weight of the siege projectiles of the European artilleries? In the table which allows this average of 6.9 kg. to be reached, mounted and horse batteries, ordinary shell and shrapnel appear side by side; are those comparable data the extremes of which are 12.763 kg. (28.0 lbs.) shrapnel of the Russian heavy gun (*canon de batterie*) and 4.280 kg. (6.4 lbs.) Italian 7-cm. (2.76-in.) shell?

The first thing to be done to compare the existing field projectiles is to divide them up in a table of four columns, if it be desired that their study be of any value.

In order not to complicate this comparison unduly, it will be limited, as it was by General Wille, to the artilleries of the six great powers. Mention will be made, as a reminder only, of the Russian heavy gun, which has small chance of being taken for the future model, and which the General mentions, however, because it is a regulation piece; our 95-mm. gun will also be mentioned as a reminder, as its construction is the product of a similar order of ideas. In this way the following table is obtained:

Powers.	Mounted Batteries.			Horse Batteries.		
	Calibre.	Shell.	Shrapnel.	Calibre.	Shell.	Shrapnel.
	mm.	kg.	kg.	mm.	kg.	kg.
Germany.....	88	7.022	8.069	88	7.022	8.069
England.....	76.2	5.680	5.680	76.2	5.680	5.680
Austria.....	87	6.360	7.160	75	4.330	4.780
France.....	90	.....	8.685	80	.....	6.280
Italy.....	87	6.760	6.960	75	4.280	4.470
Russia.....	87	6.910	7.077	87	6.910	7.077
Average.	85.9	6.546	7.272	80.2	5.644	6.059
France.....95-mm.	95	.....	12.300			
Russia.....	106.7	12.512	12.763			

Mm. equals .0393 inches. Kg. equals 2.20 lbs.

If the projectiles which General Wille has taken in a lump be grouped in this way, and care be taken to seek an average effectiveness among those which go together, wholly different conclusions are reached.

In the first place a part of the powers give their horse-batteries a gun in which lightness is sought at the expense of power; the fact that they have accepted, as a necessary evil, the disadvantages belonging to duality of calibres, shows how insufficient they consider the power of their cavalry guns for their

mounted batteries. Germany and Russia have unified their matériel but not at the cost of the weight of the projectile, which is great. England, on the contrary, has a rather weak matériel, the projectile of which, lighter than that of the other mounted artilleries, is not even up to the average of that of the horse-batteries; but there exist as yet only a small number of these guns (many batteries have still the old muzzle-loading guns), and their assignment to mounted batteries is perhaps only provisional, pending the results of studies which have been pursued for some time upon a 20-pdr. gun.

Be that as it may, the batteries to be considered, those forming the great mass of the artillery and representing the minimum ballistic power judged necessary, are the mounted batteries. Horse batteries belong to another order of ideas and should not be compared with the others. Now the average weight of the projectiles of the mounted batteries reaches 6.546 kg. (14.43 lbs.) for the shells and 7.272 kg. (16.02 lbs.) for the shrapnel, and that after eliminating the Russian heavy gun which General Wille retained, and assuming that the 12-pdr. gun has been definitely adopted for the English mounted batteries, which is by no means a certainty.

25.—Now, what is the relative importance of these two mean values?

Germany and Austria alone show great differences in weight between the shell and the shrapnel of the same calibre; but it appears that in Austria the adoption of a shrapnel model of 1891 has caused this difference to disappear\*; and it follows from two items of information published by the *Revista di Artiglieria e genio* and by the *Schweizerische militärische Blätter*, of December, 1891, that Germany is about to do the same. In Italy and Russia the difference is but 200 g. (0.441 lbs.) at most; in England there is none and France has been still more radical by doing away with the ordinary shell.

If it be proper to bring into this discussion an idea as to the tendencies which have a chance of prevailing, it may be assumed that the ordinary shells which appear in the above table will disappear some day or other. The introduction of the torpedo shell obliged the French artillery to give up the great convenience of the single projectile; and it is probable that other countries will not easily submit to carrying three different kinds of ammunition, and it is evident that in this case it is the ordinary shell which will be abandoned. This moreover is what General Wille assumes, and he does not hesitate to pronounce the death of canister into the bargain. Hence, it may be admitted that the point of having only torpedo shells and shrapnel in the ammunition chests will be reached.

General Wille demands that these two projectiles shall be of the same weight, or at least of weight very nearly the same, and such as to compensate for differences in firing resulting from their necessarily different shapes.

This principle, which allows of passing from one projectile to the other in firing without change of elevation, cannot be too highly commended. But what shall this single weight be?

\* That, at least, is what the *Mittheilungen* says in its criticism of the Wille project. It is not known whether the difference has been overcome by reducing the shrapnel to the weight of the shell, or whether it be a question of replacing the shell and old shrapnel, like our grape shell.

The true field projectile, the one intended for use against troops under normal conditions, is the shrapnel. The elevation should be determined by it and not by the consideration of the average between its weight and that of a projectile which is destined to disappear. Now, it follows from the above table that it has been deemed necessary everywhere to give to the shrapnel a weight far greater than that of the projectile first adopted with the gun and considered as normal. Where these weights are very close, it is because the ordinary shell is already relatively heavy. Where the two weights have been made the same, the shrapnel and not the shell controls. This is the case in England, where the projectiles are heavy for their calibre.

The mean of the weights of the existing shrapnel, that is the number to be considered, is 7.270 kg. (16.02 lbs.), instead of the average weight of 6.900 kg. (15.21 lbs.), invoked by General Wille. It is by no means pretended to conclude from this that a shrapnel of 6.500 kg. (14.32 lbs.) would be insufficient; experience alone can show whether this diminution of nearly 800 g. (1.76 lbs.) would not take from the projectile too much of its effectiveness. This point will have to be taken up again when considering the questions of calibre, velocity and arrangement. It was only proposed to set forth here the defectiveness of a reasoning which consists in lumping together shell and shrapnel, horse batteries and mounted batteries, so as to reach a light weight which it is finally proposed to diminish still further.

## THE COMBINED ACTION OF CAVALRY AND INFANTRY.

(Some Recent Continental Opinions.)

By EXUL.

(From the *United Service Magazine*, London.)

SIR FREDERICK MIDDLETON, in his article on "Mounted Infantry" in a recent number of the *United Service Magazine*, remarks that the Continental nations, while admitting the almost daily increasing necessity for the combined action of infantry and cavalry, have as yet shown no signs of taking steps to organize rapidly-moving infantry.

Quite recently, however, they seem to have awakened to the fact that it would be as well to do something more than admit this necessity; at recent manœuvres some serious attempts have been made to solve this problem, and at the present moment the Continental military papers are full of articles and letters discussing the pros and cons of the question.

The various opinions held on this subject may be roughly classed under three heads:

- (1) The opinions of the extreme cavalry school.
- (2) The opinions of the moderate cavalry school.
- (3) The opinions of the mounted infantry school.

The extreme cavalry school hold that the cavalry is absolutely and entirely self-sufficient for all purposes. They argue that any attempt to unite cavalry with infantry, or *vice versa*, will destroy the efficiency of both arms; that cavalry finding itself obliged to remain with infantry must *ipso facto* lose the dash and freedom of action which constitute its strength; finally, that in the Franco-German war of 1870-71, in those cases in which the combined action of cavalry and infantry was tried, the German cavalry found itself considerably hampered in its action, even when the infantry was rendered as mobile as possible by the use of carts or by other means.

The moderate cavalry school, while admitting that infantry, properly manoeuvred, is capable of affording most valuable assistance to the cavalry screen, is opposed to mounting infantry, on the plea that the mounted infantryman has always degenerated, and always will degenerate, into a bad cavalryman. The favorite argument of this school is that a man who has been taught to ride, feels when mounted a sense of superiority over his dismounted comrades, which no teaching can wholly eradicate; and that for this reason it must always be extremely difficult to prevent mounted infantry usurping the rôle of cavalry.

The mounted infantry school maintains that the mobility of a certain portion of infantry should be so increased that it may be able to keep within constant touch of the cavalry, without in any way diminishing the freedom of action of that arm. For the most part those who hold this opinion seem to be indifferent whether the infantry be mounted on horses or bicycles or in carts. They one and all maintain that the great principle to be observed is that the infantry should remain infantry, and should be entirely independent on the field of action to mount whatever form of locomotion be selected. Austria may lay claim to be the first great military Power to attempt the solution of this problem. The reason for this is obvious: the natural opponent of Austria, in the case of an European conflict, is Russia.

Now Austria is numerically very much weaker than Russia in point of cavalry; she therefore finds herself obliged to seek some support for that arm against the Cossack raids with which she is threatened in the event of war. What better support could she find than the infantry?

What I have called the moderate cavalry school is, or at any rate was at the time of which I am writing, in power in Austria. Hence it was that the principles of that school were put to the test at the last autumn manoeuvres. The troops who undertook the new duties were not without some preliminary training in the rôle they had to perform. The country chosen for the field of operations was the neighborhood of Schwarzenau, in the valley of the Danube, near the Waldviertel, a district admirably adapted to military operations. The forces employed numbered altogether about 70,000 men, of which about 8000 were cavalry. Thus everything was favorable to a thorough investigation of the question.

With the general plan of the manoeuvres we have nothing to do. It was in the first day's operations—that is to say, in the movements of the two cavalry screens—that the proposed combination was put to the test. That the result of the day's operations was expected with interest elsewhere than

in Austria, is proved by the fact that the German Emperor, the King of Saxony, and General Von Schlieffen, the chief of the general staff, watched the manœuvres throughout with the utmost attention.

Unfortunately, as will be seen, the result was a dismal failure, and so badly were the troops handled that it cannot be said that the principles involved were given at all a fair trial. This is what happened: Each general sent forward an independent division of cavalry, with its infantry supports. The orders given were to drive in the enemy's cavalry, to reconnoitre, and obtain as much information as possible. The two divisions advanced against one another, but instead of scouring the country with the ordinary dash and sagacity of cavalry, they remained constantly attached to their infantry, thus entirely sacrificing the mobility which constitutes their strength, and without which cavalry has no *raison d'être*. They gradually approached the point of contact, but with an extraordinary timidity; they were independent only in name, and throughout the operations seemed much more occupied in keeping in touch with their infantry supports—which utterly paralyzed and hampered their movements—than in observing the enemy and obtaining information. At length the collision occurred. One division surprises the other in an inferior position, and drives it in; but is in its turn repulsed by the infantry supports. Neither division seems to have done anything in the way of reconnoitring—the duty which it was sent forward to perform. If the most ardent detractors of the use of mixed divisions had been in command of the opposing forces, they could not better have demonstrated the inanity of the system.

But the experiment was so far valuable in that it called forth immediately a number of alternative propositions, some of which are very interesting. The extreme cavalry school contented itself with a triumphant "I told you so."

The moderate cavalry school disclaimed, for the most part, any connection with the way in which the mixed divisions had been handled in the Austrian manœuvres. It declared that its principles had been entirely misunderstood, and suggested as a typical method for the manœuvring of combined infantry and cavalry forces. The cavalry division should, as heretofore, be sent forward long distances in front of the army it is intended to screen; it should be left entire liberty of action in its reconnoitring duties, and should be followed by the infantry supports, advancing, by forced marches, to points fixed beforehand. Communication should be maintained with the cavalry in front by means of gallopers. In the case of a reverse, or when driven in by superior bodies of the enemy's troops, the cavalry would be able to reform behind the infantry supports, and resume the offensive when the pursuing cavalry had been beaten off by the infantry. Thus, argue the advocates of this system, both arms could manœuvre together, and afford each other a mutual support without either in any way sacrificing its peculiar methods of fighting.

The mounted infantry school maintains that the result of the manœuvres has been to conclusively prove the necessity of mounting infantry in some way or other, and so giving them, to a certain extent, the mobility of cavalry, and avoiding the error into which the Austrians had fallen, of reduc-

ing the speed of the cavalry to that of the infantry. A French advocate of this principle has recently proposed to form what may be called a "cart corps." He says that forty vehicles of the form and size of a London omnibus, with 120 horses, would suffice for the transport of a battalion of 800 men, with sufficient food, ammunition, and baggage for four days. He proposes that each *corps d'armée* should have at least two such battalions.

It would seem possible, if an infantry force of this description could be organized, to break through the enemy's screen with a force of the three arms combined. The cavalry, sure of a strong support close in its rear, would be in a condition to act with more boldness and obtain more valuable information than if acting independently. The author of this proposition further suggests that the infantry, when attacked in superior force, might with advantage use its wagons as a *zareba*. It is probable that this suggestion will, before long, be put to a practical test in France.

A final suggestion appears in *Le Progrès Militaire*. "The incident in the Austrian manoeuvres," says the article alluded to, "of a division escaping from the pursuit of the opposing cavalry, thanks to the fire of its infantry supports, reminds us of a similar incident which occurred at the battle of Rezonville, on the plateau of Ville-sur-Yron, on the right wing of our line of battle. A body of our cavalry, numbering some 5000 men, charged the enemy, but were repulsed. Our squadrons turned rein and attempted to reach the village of Bruville at a gallop, vigorously pursued by the German cavalry. But these had in their turn to retire before the fire of a few groups of the 2d Chasseurs d'Afrique, who had been dismounted at the beginning of the charge, and, having occupied the small wood of Ville-sur-Yron, covered with their carbines the retreat of their comrades."

There was nothing extraordinary in this event. It is generally admitted, to-day, that cavalry cannot charge successfully in the face of musketry fire. What does it matter whether the bullet which stops the charge is fired by an infantry soldier or a dismounted trooper? If, then, a force of cavalry finds itself opposed to an enemy, superior in numbers or position, why should not the weaker party dismount its men and receive the enemy with musketry fire? It would certainly be less brilliant and less picturesque than a charge with colors flying and sabres flashing, but would it not be sound tactics?

It will be seen from the above that the question of mixed forces is being eagerly discussed in all its aspects on the Continent. Further, France has recently drawn up a new *règlement* for the use of cycles in warfare, though in it the cyclists are relegated to the minor rôle of despatch-bearers.

Continental soldiers seem, as a whole, more opposed to mounting infantry on horses than we are in England, chiefly, I should imagine, because they consider that the same results can be obtained, with less expense, by other means.

I am afraid I cannot agree with Sir Frederick Middleton's statement that Private Thomas Atkins takes more readily to the horse than the Continental linesman. We may be a nation of horsemen, but I do not think the "horsiness" extends, as a rule, to the ordinary infantry recruit.

It is told of a certain gallant regiment, in South Africa, that when called

upon to furnish a mounted infantry detachment, its men volunteered for the duty *en masse*. The most "horsy" were selected; but, in spite of this, when ordered to start, at the end of the day's preliminary training, the gallant detachment preferred to decline the proffered honor of a musical "send off" by the local band, as they did not feel confident that their mounts would appreciate the attention!

## ABSTRACT OF MUNROE'S LECTURES ON CHEMISTRY AND EXPLOSIVES.

BY LIEUT.-COLONEL J. P. FARLEY, ORDNANCE DEPT. U. S. A.

(By permission.)

**D**URING the summer of 1888, a very interesting and instructive course of lectures was delivered to the class of that year by Prof. C. E. Munroe, S. B., F. C. S., etc., at the Torpedo Station, Newport, R. I.

The series appears in Torpedo Station print for the same year as a volume of 400 pages, and in view of its limited circulation it is thought that a brief *resumé* of the same may prove of interest to the readers of the JOURNAL.

An attempt has been made to follow the general sequence of arrangement under the various headings of "chemistry," "combustion," "gunpowder," "chlorates and nitro-substitution compounds," etc., etc., but the form of expression and presentation of facts are materially altered from the original in the condensed shape required.

### COMBUSTION.

Combustion we are informed is the result of chemical union between atoms of combustible substances and supporters of combustion; heat and light result from the impact of the atoms; mechanical energy is converted into heat, and the potential energy is lowered.

Oxygen and hydrogen in water proportions when ignited are followed by rapid combustion; the mixture itself constitutes detonating gas, which is produced by electrolysis and has been suggested for use for torpedo-charges.

Gases and volatile liquids when mixed with air in certain proportions and ignited give rise to explosions.

Finely pulverized solids, such as coal-dust, sawdust, starch, flour, and fine zinc dust mixed in certain proportions with air undergo rapid chemical change or ignition.

Solids disappear during combustion and the volume of gases generated increases in bulk with the heat developed. Gaseous compounds of carbon (C), hydrogen (H), and sulphur (S), form with oxygen  $\text{CO}_2$ ,  $\text{H}_2\text{O}$  and  $\text{SO}_2$ . The coefficient of expansion of a gas for  $1^\circ \text{C.}$ , is  $\frac{1}{273} = .003665$  and from this we may determine pressures for a constant volume and varying temperature.

Radiation, conduction and convection reduce the heat of combustion, but the heat evolved during the reaction is compensating. The materials of explosives should be pure, and the mixtures intimate. Oxygen may be supplied either in the free state to the carbon (C), or else combined, as in  $\text{KClO}_3$ . A mixture of charcoal and potassium nitrate is best adapted for use in ordinary guns and to this sulphur is added in order to lower the point of ignition.

#### EXPLOSIVES—GUNPOWDER.

Gunpowder a mixture of  $\text{KNO}_3$  75%, C 15%, S 10% is nervous, sensitive and susceptible to the slightest change of temperature,—to mist, sunshine and dew, whereas, many of the explosive compounds are stored for preservation in water, and are but slightly affected by variations of temperature within reasonable limits.

Col. Rains (Confederate service) incorporated gunpowder by steaming the powder and afterwards rolling it. The Russian Wiener powder has its moisture eliminated at the melting point of sulphur ( $240^\circ \text{F.}$ ), and although of uniform density, the grain is porous and absorbs moisture.

Fossano or Progressive powder is an agglomeration of powders of two densities, fine and coarse grain.

The composition of Cocoa powder is a trade secret, but from analysis it is thought to be made with underburnt "club moss" charcoal. Its ash contains alumina in quantities not found in the ash of woods usually used for gunpowder charcoal.

Dupont's Brown powder consists of saltpetre 78%, sulphur 2.8 to 3%, a carbo-hydrate (such as sugar) 3 to 4%, and baked woods (underburnt) 12 to 12.5%, which latter retain their fibrous structure. This powder gives high initial velocity with a low maximum pressure and possesses advantages over black powders owing to the form, size, density and hardness of grain, which features, combined with a lesser proportion of sulphur, reduce the readiness of ignition. After the initial movement of the projectile the grains are somewhat broken up, which new condition, added to the greater inflammability of the underburnt charcoal and carbo-hydrates, promotes chemical reaction and maintains the pressure.

Loss of velocity in gunpowder during storage is thought due to the action of the oxygen condensed in the pores of the charcoal which oxidizes the sulphur to  $\text{SO}_2$ , which by union with the water present is transformed into  $\text{H}_2\text{SO}_4$ , which then decomposes the  $\text{KNO}_3$ , forming  $\text{K}_2\text{SO}_4$  and  $\text{HNO}_3$ . This  $\text{HNO}_3$  induces further oxidation and the cycle of changes proceeds again and again, its rapidity being increased with time. It is this inert  $\text{K}_2\text{SO}_4$ , therefore, which serves to retard the velocity of combustion.

During explosion of gunpowder the following chemical changes take place. The oxygen of the nitre converts the charcoal chiefly into  $\text{CO}_2$ , part of which assumes the gaseous state, while the remainder is converted to  $\text{K}_2\text{CO}_3$ . The greater part of the sulphur is converted into  $\text{K}_2\text{SO}_4$ , and the chief part of the nitrogen contained in the nitre is evolved uncombined. Potassium carbonate, potassium sulphate, carbon di-oxide and nitrogen result, the two last being gases, which are expanded by the heat of combustion.

## CHLORATES AND NITRO-SUBSTITUTION COMPOUNDS.

Na NO<sub>3</sub> (Sodium nitrate) can be substituted for KNO<sub>3</sub> for blasting and other powders. Ammonium, barium or lead nitrates have been used with considerable success, but the latter gives off poisonous fumes. The chlorates contain less oxygen than the nitrates, but give all of it up during the reaction, whereas with the nitrates some of the oxygen remains attached to the acid radical.

Chlorates are decomposed at 352° (C) whilst oxygen is not evolved from the KNO<sub>3</sub> until red heat is reached and combustion of bodies in contact with chlorates results in developing very high temperature; greater by one-half than that of the nitrate powders, therefore they possess greater force.

Chlorate powders are sensitive to friction and percussion, explode with sharpness, erode the walls of the gun to a greater extent than the nitrates, and the chlorine gas liberated after firing is deleterious to those who are exposed to its action. The manufacture and handling of the powders is attended with risk and is comparatively costly.

The chlorate powders have been used in fulminating primers and percussion caps. Siemens takes saltpetre, chlorate of potash and a solid hydrocarbon, and mixing the same he treats the product with a liquid volatile hydrocarbon as a solvent for the solid hydrocarbon. The mass is plastic and after passing through rollers is rendered hard by evaporating the solvent. The cakes are then broken up and converted into grains. This powder has the same density, greater hardness, and double the force of ordinary gunpowder.

Mellard's paper powder consists of

Potassium Chlorate.....	9
"    Nitrate .....	4.5
"    Ferrocyanide.....	3.25
"    Chromate .....	1/16
Charcoal.....	3.25
Starch .....	1/21

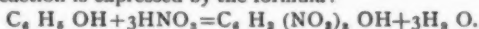
Porous paper when dipped into the liquid is rolled into cartridges, dried and coated with xyloidine.

This powder is cheaper than other chlorate powders, fairly safe and easy to make; it gives off very little smoke, leaves but little residue, is only slightly erosive and is more powerful than gunpowder.

A chlorate powder termed "White powder," being very erosive in its action on iron and steel, its use was restricted principally to bronze guns and shell charges. The shells contain the "White powder" and glass bulbs filled with sulphuric acid, which latter break on impact. This principle of explosion by *admixture* has been applied in the use of certain contact torpedoes; the charge, consisting of black powders, being fired by means of sulphuric acid and "White powder." It has also been applied in pile driving; the explosion not only drives the hammer back, as intended, but also drives the pile forward an additional amount and accelerates the work.

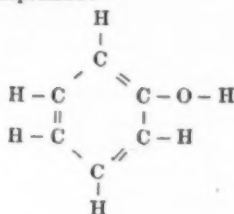
Explosive substances before referred to, such as nitrate and chlorate mixtures, have been produced by mixing combustible matter and oxidizing salts. The next step is the introduction of oxidizing agents into chem-

ical molecules by chemical means, these molecules being composed chiefly of atoms which have a strong affinity for oxygen and form with it under suitable circumstances very stable and permanent substances whereby a great degree of intimacy is obtained. This combination with hydrocarbons may be effected through the agency of the oxides of nitrogen and it may result in the formation of two classes of compounds, viz.: nitro-substitution compounds, in which the nitrogen oxide is directly attached to the carbon atoms, and nitric ethers or *esters*, in which the nitrogen oxide is connected to the carbon atoms, through the interposition of oxygen atoms. The best example of the first class is picric acid, which is made by the action of nitric acid on indigo, or of nitric acid on phenol (carbolic acid). The latter reaction is expressed by the formula:



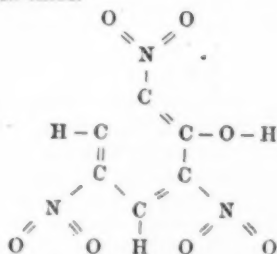
Picric acid was discovered by Hausman in 1788, resulting from the action of nitric acid on indigo. By Weller, in 1795, nitric acid on silk; but the best and cheapest method and the one used for making commercial picric acid is derived by the action of nitric acid on phenol (carbolic acid).

The reaction is thus expressed :

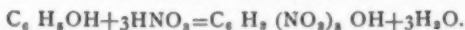


PHENOL.

Below it is seen that three atoms of hydrogen have been replaced by three atoms of nitrogen oxide.



TRI-NITRO-PHENOL OR PICRIC ACID.



Phenol is a product of coal-tar, and the picric acid thus produced is an important article of commerce, in fact one of the cheapest and most brilliant of the yellow dyes.

It can be prepared experimentally by putting two teaspoonfuls of fum-

ing nitric acid in a glass flask of 150 cm. capacity and adding cautiously and in small portions half a teaspoonful of crystalized phenol. The reaction is very violent and is attended by copious development of nitrous fumes. When the action has subsided and the flask becomes cold, yellow crystals of picric acid will be found in the liquid. Picric acid is made commercially by melting carbolic acid, mixing it with strong sulphuric acid and then diluting the sulpho-carbolic (or "phenol sulphuric acid") with water, after which it is run into a tank containing nitric acid. The mixture is allowed to cool and the crude picric acid crystalizes out.

The crystals are again dissolved in water by the aid of steam, cooled and crystalized and a third time dissolved, this time in hot water, then cooled and allowed to crystalize, after which any excess of water is removed by a centrifugal machine. Great differences of opinion exist respecting the explosiveness of picric acid. No one is prepared to say, however, that under no circumstances unconfined picric acid can be exploded by action of fire, but when mixed with metallic nitrates explosion will then surely result. It can when unmixed be exploded by detonation or blow, and when mixed with the metallic nitrates, if detonated, it is highly explosive. In 1873, Sprengel stated that picric acid, without help of foreign oxidizers, is a powerful explosive, even when fired without a detonator, and that such explosion is not accompanied by smoke. Turpin, in 1885, exploded picric acid by employing a powerful fulminate detonator, or by an intermediate priming of picric acid in powder primed with a fulminate; also by employing a large charge of ordinary brown powder enclosed in a strong tube and made to burn *inside* of the picric acid charge.

Picric acid may be perfectly detonated by means of a five (5) grain fulminate detonator.

Detonating a small quantity of picric acid will detonate a quantity of the same acid at a distance from it, and detonating a charge of picric acid placed along side of another charge of the same acid containing 17% of water the former will also cause the detonation of the latter.

When picric acid is near its melting point (240° F.) one pound falling 14" will explode it. When cold and in thin sheets (dry or powdered) one pound falling 26" will explode it.

Berthelot, confirming Desortiaux, states that should a nitro compound (nitro-benzene or naphthalene) such as picric acid, while burning in large masses, by chance, heat the containing inclosure or vessel sufficient to induce incipient deflagration, this deflagration may combine to further increase the temperature of the inclosure and detonation with result.

The large number of compounds denominated picrates (of which ammonium and potassium picrates are the principal ones) are with the exception of the ammonium picrate easily exploded by heat or blows. The ammonium picrate although containing the most oxygen requires a large addition of oxygen to insure complete combustion, and is therefore the least sensitive of the picrates, whereas the barium picrate, which although it contains the least oxygen requires the least amount of oxygen of all the picrates for combustion, is, in consequence, the most sensitive of the picrates. Potassium picrate  $C_6H_3(NO_2)_3OK$ , is one of the most violent

of all the picrates in its action. It is made by mixing potassium carbonate, warm, with a solution of picric acid in water. On cooling, the liquid deposits small crystalline needles of a golden yellow color, which show green and red by reflected light. Its explosive qualities increase much by oxidizing agents and especially with potassium chlorate and almost equal those of nitro-glycerine and gun-cotton in violence, but owing to its sensitiveness to friction and percussion it is perfectly useless.

The Designolle cannon powder consists of potassium picrate 16, potassium nitrate 74, and charcoal 9. A shell charged with this powder will be broken into six times as many fragments as when charged with gunpowder. It does not erode the piece, gives scarcely any fumes, and its ballistic properties are much superior to those of gunpowder,—notwithstanding this powder is the more *brisant* of the two.

Spontaneous decomposition is not anticipated, such as sometimes occurs with nitro-glycerine and other nitric esters, owing to the definite composition and known reactions of this, as well as of the whole series of crystalline bodies denominated picrates.

Ammonium picrate  $C_6H_3(NO_2)_3ONH_4$ , is prepared by saturating warm picric acid with concentrated ammonia water. After this operation has been repeated with slight modification several times, the liquid is allowed to stand and the salt crystallizes out in transparent orange colored prisms. It may also be obtained in citron yellow needles by treating picric acid with ammonium carbonate.

Abel's picric powder is composed of ammonium picrate 42.18, potassium nitrate 53.93, charcoal 3.85.

Its force is greater than that of gunpowder in the ratio of 1.75 to 1. It can be moistened, worked and granulated as is the case with ordinary gunpowder. Its color is yellow-green and it gives off the same colored smoke. This powder it is said does not contain a sufficient quantity of saltpetre.

Ammonium picrate and potassium nitrate solutions undergo mutual decomposition when mixed, but it is singular that no such change takes place when they are simply moistened. For this reason the manufacture of this Abel's powder is rendered quite safe.

S. H. Emmons dissolves an excess of commercial picric acid by aid of gentle heat, in fuming nitric acid, the mixture being a refrigerating one. When evaporated, three grades of crystals at different stages are deposited approximating in composition  $C_6H_7(NO_2)_3O_8$ .

This material when mixed with metallic salts is explosive and in making emmensite this body, which is called "Emmens' acid," is mixed with both picric acid and a nitrate, preferably ammonium nitrate, and the whole fused together and cast in moulds. The result is a solid mass of bright yellow color, bitter taste, nearly inodorous and with porous structure. It is claimed to be insensitive to shock, blow or fire, but more powerful than nitro-glycerine when detonated and when used in the granulated form for a projecting charge it produces but little smoke and does not foul the bore of the gun.

Nitro-substitution compounds may be formed from hydro-carbons, such as benzene and naphthalene. When one atom of hydrogen is replaced by

$\text{NO}_3$ , there results mono-nitro-benzene. This when mixed with potassium chlorate in the ratio of 21 to 79, gives Rack-a-rock, 204,400 pounds of which were used in blasting Flood Rock. This mixture is made either by pouring the liquid on the solid or by immersing the solid (potassium chlorate) in the liquid, the solid being held in wire baskets. A 24-grain fulminate fuse scarcely suffices to explode this compound when not confined or but slightly confined, which is its chief objection.

In phenol (carbolic acid) the substitution of  $3\text{NO}_3$  for three atoms of H gives the tro-nitro-phenol or picric acid as before shown. Bellite, discovered by Carl Lamm of Sweden, consists usually of Meta-di-nitro-benzene with ammonium nitrate, which are melted together at  $160^\circ \text{F}$ . and mixed with saltpetre. When pressed warm it has a specific gravity of 1.2 to 1.4 and a gravimetric density of .8 to .875. When heated in an open vessel to  $360^\circ \text{F}$ . separation results and evaporation takes place. It burns if heated suddenly, but ceases to burn when the source of heat is removed. It absorbs but very little moisture from the air after it has been pressed.

Under powerful blows it heats but neither ignites nor explodes, in fact it may be said to withstand blows, friction and vibration, and can be stored or transported with perfect safety. It is the opinion of those best qualified to judge, that it is as well adapted for military purposes as for mining and blasting, and bids fair to become of great importance.

Securite is one of the varieties of bellite and consists of a nitrated hydrocarbon mixed with an oxidizing agent, such as potassium chlorate and with some organic salt, which renders it flameless. Its power is said to be equal to dynamite and it is exploded only by the detonating cap.

Hellhoffite is a solution of a nitrated organic compound (naphthalene, phenol, benzene and the like) in fuming nitric acid. It has the same advantages as bellite, but the disadvantage of being liquid. The fuming nitric acid contained in it requires that it shall be stored in closed vessels. As it is rendered completely inexplosive by being mixed with water, it cannot be employed for work under water.

Gruson's explosive of 1881 appears to be especially adapted to all military purposes, whenever a safe but violent explosive is required. It is a secret compound made by dissolving certain crystals in nitric acid, and is probably similar to Hellhoffite. Its ingredients are transported separately and mixed only for use. It requires twice as powerful a detonator as that which explodes dynamite and when mixed may be neutralized by adding water, the crystals separating out. These crystals burn like sealing wax, but neither the crystals nor the mixture can be frozen at  $0^\circ \text{F}$ . The crystalline ingredients are some well-known substance which is freely transported, but what it is we are not informed; this is Gruson's secret. The ingredient is not soluble in water, does not absorb moisture and therefore never becomes damp. The solid components of Gruson's explosive look like brown sugar, the crystals are needle-like, and nearly an eighth of an inch in length.

They burn in the flame of a Bunsen burner with much smoke. If dissolved in nitric acid a drop of the same when placed on an anvil and hammered will not explode. Paper dipped in the solution serves the purpose

of a wick when ignited, and burns with increased flame, but without igniting the solution. Water poured on the solution causes recrystallization, but this change is not attended with material reduction of temperature, the crystals may then be separated from the nitric acid.

In a tube, exploded by a primer three times as strong as that required for dynamite, its force or energy is estimated as 1.3 to 1 of that of nitroglycerine.

Hellhoff made an explosive from crude coal tar, but found that the treatment of coal tar with strong nitric acid was a very dangerous operation. Acid of 1.33 to 1.45 specific gravity was used and liquid coal tar gradually stirred into it, the surface of the acid at first becoming covered with the coal tar, which gradually settled to the bottom. The substance thus obtained when washed and purified was mixed with oxidizing bodies (alkaline nitrates, chlorate of potash and the strongest nitric acid being used for this purpose).

Two to five parts of concentrated nitric acid or four to six parts of salts were sufficient for one part of the nitro-derivative.

It was found in the course of experiment that either pulverized coal or peat after treatment with nitric and sulphuric acids, when soaked in a solution of chlorate of potash and dried, forms a powerful explosive, and all nitro-derivatives from either of the above ingredients are stronger and better when mixed with oxygenated bodies.

The Sprengel class of explosives of 1873 consists of two liquids, or one liquid and one solid, kept separate until needed for use. Amongst the oxidizing agents were the nitrates and chlorates which are solid and nitric acid and nitrogen tetroxide, which are liquid.

#### FULMINATES.

The class of fulminates include the salts of fulminic acid and other substances, which under normal conditions undergo detonating explosion only.

Nitrogen chloride is one of the most unstable of the class of fulminates, and although sensitive and dangerous, and its local action is marked, due to detonating reaction, yet its explosive force (Sarrau) is but slightly greater than that of gunpowder. It was discovered by Dulong in 1812, and resulted from the action of chlorine on ammonium chloride. Some chemists regard it as  $\text{NCl}_3$  (trichloramide), that is ammonia  $\text{NH}_3$ , in which all the hydrogen has been replaced by chlorine  $\text{NCl}_3$ .

Berthelot discovered (1788) Silver Amine, a powerful fulminating compound produced by the action of ammonia upon silver oxide. It may also be produced by precipitating silver nitrate with sodium hydroxide and washing the silver oxide by decantation. This body explodes by the slightest concussion when dry and requires the greatest caution in handling even when moist. It is claimed to have been the detonating agent used in the bomb that killed the Czar.

The "Fulminating Gold" is formed as a buff precipitate by adding ammonia to a solution of auric chloride, a violent explosive resulting.

Cupricamine is formed by passing a current of dry gaseous ammonia over finely powdered cupric oxide heated to  $250^\circ \text{C}$ ., water and nitrogen gas

are evolved, and the nitrate is left as a dark green powder, which when heated to  $310^{\circ}\text{C}$ . explodes freely.

Mercury amine may be made by passing gaseous ammonia over the dry yellow mercury oxide, which is precipitated from mercury salts by an alkali. This may be continued so long as the gas is absorbed, and by heating the resulting black-brown mass constantly (at a temperature not exceeding  $150^{\circ}\text{C}$ .), so long as water is given off. An anhydrous brown powder is produced, which detonates powerfully when heated or struck, and which is decomposed by acids with salts of ammonium and mercury.

Fulminating Platinum is produced as an insoluble black powder by dissolving ammonium platinic chloride in a solution of sodium hydroxide and adding an excess of acetic acid. It detonates violently when heated to  $200^{\circ}\text{C}$ .

Nitrogen Sulphide. This body detonates powerfully under percussion, but is less sensitive than diazo-benzene nitrate or mercury fulminate. It deflagrates at  $270^{\circ}\text{C}$ ., but more slowly than mercury fulminate. It is made by passing dry ammonia gas through a solution of sulphur dichloride in ten or twelve times the volume of carbon bisulphide.

Howard, an English chemist, discovered Mercury Fulminate in 1800, and with this substance began our knowledge of what are chemically known as fulminates. The discovery was made while acting on mercury oxide with alcohol and nitric acid, a whitish salt was produced, which crystalized in acicular needles possessing a saline taste and which when dried exploded with extreme violence when a drop of sulphuric acid was poured upon them. This compound gives extremely low velocity as a propellant, but bursts the gun by the violence of its action. In 1863 Nobel employed fulminate of mercury to detonate nitro-glycerine. It is a salt of an organic acid having the probable proportions  $\text{C}_2\text{N}_2\text{O}_3\text{H}_2$ , and which is known as fulminic acid.

This fulminate is now made by taking 10 parts by weight of mercury and dissolving it by gentle heat in 120 parts by weight of nitric acid s.g. 1.4. It is then poured into a glass containing 100 parts of alcohol (95%), the flask holding six times the volume of the alcohol. At a temperature of  $60^{\circ}\text{F}$ . action begins, the mixture becomes turbid and generally continues so until the reaction is completed. From 11 to 12 parts of mercury fulminate result from every ten (10) parts of mercury. The fulminate will be found as a pasty mass of fine gray crystals of uniform color, and if different colors are exhibited or globules of metallic mercury are seen, it indicates that the operation has not been properly carried out, and the charge is then known to be unfit for service.

Dry fulminate explodes violently when struck or compressed, or when rubbed between hard surfaces; when heated to  $186^{\circ}\text{C}$ .; when touched with strong sulphuric or nitric acids; when in contact with sparks from flint and steel or from the electric spark. If wet with thirty per cent. of water it is inexplusive except when dry fulminate is detonated in contact with it. Its density is 4.42 and the reaction attending decomposition is thus expressed :  $\text{Hg C}_2\text{N}_2\text{O}_3 = \text{Hg} + 2\text{CO} + \text{N}_2$ .

The superiority of the fulminate of mercury over all other fulminates is

due to its nearly instantaneous decomposition by simple inflammation to the absence of dissociation products and finally to its great density. Definite products of combustion form at once before even the matter has time to take a volume notably superior to that of the primitive solid. Hence if exploded in a vessel and in contact with its sides, it will develop an instantaneous pressure, incommensurately greater than its mean pressure, which latter is controlled by the capacity of the receptacle. Mercury fulminate, with an absolute density 4.42 in contact, develops a pressure of 48000 atmospheres, while compressed gun-cotton in contact develops a pressure of not more than 24000 atmospheres and no other substance in contact will give a pressure at all comparable with that of the fulminate of mercury. This circumstance joined with that of the absence of dissociation makes the compound perfectly irresistible.

The composition for percussion caps consists of 100 parts dry fulminate, 30 water, 50 saltpetre and 29 sulphur, the whole being mixed by rubbing with a wooden pestle on a marble slab. It is dried sufficiently to be granulated, is forced into copper caps and when perfectly dried is varnished or covered with tin foil to protect it from dampness. The caps are finally dried by a gentle heat and packed in boxes.

The detonators employed in the Navy consist of a copper case made in two parts. The lower part is a No. 36 metallic cartridge case and is  $1\frac{1}{8}$  long and  $11\frac{1}{32}$  inches in diameter. The upper part is a copper tube  $\frac{5}{8}$  inches long and  $12\frac{3}{32}$  inches in diameter, open at both ends, which has been cut from a No. 38 metallic cartridge case. A  $\frac{3}{16}$ -inch thread is cut on each of these parts so that the upper part or cap screws nicely into the lower part. The lower part is fitted with fulminate of mercury up to the lowest thread of the screw. The top part is fitted with a plug made of sulphur and glass through which the detonator legs pass to connect the bridge with the wires leading to the battery. When the fulminate is dry the spaces in the lower case and the cap are fitted with pulverulent dry gun-cotton and the parts are screwed together.

The different grades of detonators, known as blasting caps, are known as single, double, triple, quadruple and quintuple force caps. The single contain three grains of fulminate, the others increase by three, and hence the quintuple contains 15 grains. They usually consist of 75% of mercury fulminate and 25% of potassium chlorate, pressed into the caps under high pressure and a little gum is added to make it more coherent. The presence of chlorates, nitrates, sulphur, etc., give rise to flame and incandescent particles, whereas mercury fulminate *per se* does not produce either.

In silver fulminate the acid hydrogen is replaced by silver instead of mercury. Certain precautions are to be used in its manufacture. Large vessels are employed to prevent boiling over, which latter would permit the salt to dry on the outside of the vessel and lead to accidental explosion. All flame must be kept away lest the vapors should take fire and explode. The mixture should be stirred with wooden rods and not hard ones of glass or metal. Paper shovels should be used in removing it, and the fulminate must be kept in pasteboard or paper boxes to avoid the friction of glass stoppers. Finally the vessels holding it must be loosely covered to prevent

explosion due to pressing the cover of the box to fit it. The silver fulminate is very poisonous; it consists of white opaque shining needles with bitter metallic taste; dissolves in hot water and separates on cooling. It explodes much more violently than mercury fulminate by heat, the electric spark, friction, percussion or by contact with oil of vitriol.

It explodes at 130° C. when dry or when rubbed by hard substances such as glass dust, sand, or even the edge of a card. It may be rubbed to powder in a porcelain mortar either with a cork or by the finger. If well washed and dried by exposure to the sun, it explodes by the slightest touch. It is used very largely for crackers and detonating toys.

Besides those mentioned, a large number of salts of fulminic acid are known, all of which are unstable and explosive.

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## CAVALRY IN THE PAST, THE PRESENT AND THE FUTURE.

BY A SUPERIOR OFFICER OF CAVALRY.

*From the Revue de L'Armée Belge.*

By LIEUT. J. C. BUSH, 5TH ARTILLERY.

THE numerous resources which steam and electricity have placed at the disposal of armies, as well as the continual improvements brought about in their armament, while causing infantry and artillery to modify their tactics, compel cavalry to extend its rôle on the one hand, and on the other, to seek for the best manner of utilizing its principal means of attack—shock and the white weapon.

The power of shock, we know, is in direct proportion to its velocity, and the velocity being limited, we must conclude that it is not in this direction that we can expect progress. A certain result may be obtained by reducing the load borne by the horse, but we may be sure that such an improvement will not in itself counterbalance the great increase of power acquired by infantry and artillery.

"Cavalry, moreover," writes General Trochu, "is not so much the instrument of great shocks as of great moral effects which paralyze, disorganize and produce incalculable results under given circumstances." And we may add:—The value of a charge is shown, not by its physical but by its moral effect, and that which produces the maximum moral effect is not the shock itself, but the rapidity and suddenness of the charge. Another direction must be taken therefore if we wish to find the means of making cavalry participate in the progress of the other arms, to keep it abreast with recent improvements and finally to reestablish that balance so necessary to the regular play of all the organs of the military machine called the army.

Let us glance into the past; there we will see the great masses of cavalry of the Napoleonic epoch and can compare the results obtained during this period with those which crown the efforts of the cavalry of to-day.

Under Napoleon the employment of cavalry masses was excessively frequent and it was not rare to see 40, 80 or 100 squadrons, united under a

single chief, rush upon the enemy like a torrent, overthrowing him, crushing him and producing what the Emperor called "the event," that crowning effort, the apotheosis of action.

In studying the cavalry attacks at Austerlitz, Eylau, Essling, La Moskowa, we see that these charges are true avalanches, which like cyclones throw down and sweep away everything in their path. The French cavalry led by such illustrious chiefs as Kellermann, Murat, Nansouty, Colbert, Montbrun, Lasalle, Ney, and many others, fell upon the enemy, penetrated his ranks like a wedge, shattered all resistance with the white weapon and often decided the fate of battles.

At the recital of these great facts, in reflecting on the immortal glory acquired by the cavalry of the First Empire, our imagination is excited and we feel compelled to believe that no infantry in the world can withstand such shocks, that no force of men exists equal to stopping a cavalry resolved to die, provided any portion remains for attaining the desired end.

But nevertheless, if we turn to the heroic charges at Woerth, Vionville and Sedan we are forced to admit that the glorious sacrifices made by cavalry in 1870 were far from producing the results expected of them.

From whence comes this great difference in the effect obtained by two cavalries equally brave, equally vigorous and both led by energetic and chivalric chiefs?

We need not attribute it to other causes than differences in armament, modifications occurring on the surface of the ground, and finally to changes in tactics.

Let us examine successively each of these three factors.

## II.

Since the introduction of rapid-firing, long-range arms and the adoption of rifled guns, it has become difficult, if not impossible, to screen cavalry behind the first lines. Besides, suppose that they do find cover there, this cover will rarely be sufficiently extensive to contain masses of troops and the plunging fire of the enemy will soon render it untenable.

Cavalry must take position beyond effective range, that is to say too far from the action. It cannot be on hand at the proper time and we know that unfortunately the favorable moment for a charge passes away like lightning. Therefore infantry temporarily shaken will always have time to reform.

As to attacking infantry in position, or even intact, this will prove a hazardous and bold undertaking. The enemy will be able by his fire-action to oppose such a resistance that cavalry will run great risk of being put to rout, or at the very least, entirely broken up before arriving at the enemy.

"Cavalry," writes General Bonie, "having now to pass over ground five or six times more extended than formerly, in order to arrive at its object, is exposed to five or six times greater loss.

"Now, as formerly, it is the rule not to launch cavalry against unshaken infantry, and it is unquestionable that this principle is truer now than ever before. We cannot therefore neglect it under pain of seeing our troops annihilated.

"Nevertheless, we cannot deny the influence which a brave cavalry energetically led, will always exert on infantry, and when the latter become shaken and begin to waver and give way, it is unquestionable that a torrent of men and horses, rushing on them and enveloping them on all sides, will produce incalculable havoc and most often a complete rout.

"In order to obtain this result we must be able to hold cavalry as near as possible to the infantry. Under the Empire nothing was more easy and the squadrons found themselves hardly 200 metres behind the lines. Modern fire-arms, which permit the combatants to enter upon a kind of delaying action at a distance, leave cavalry for a long time idle and exposed to fire; this will cause them useless losses and will require too great an expenditure of moral force. For nothing is so trying and nothing renders troops so nervous as to receive fire without being able to return it.

"On the other hand, with the considerable development of front taken up by belligerents in modern battles, to return to the ancient system of placing cavalry on the wings would result in constantly depriving it of opportunities for affording that powerful support which it can give by intervening in time at a proper point. For, seen at a distance, this opportunity will almost certainly be lost by a tardy arrival.

"Hence, according to our way of thinking, so long as the place of cavalry cannot be clearly indicated by a precise rôle in advance of the lines or on the wings, the true idea will consist in placing it sufficiently in rear of the troops whom it is going to support to shield it from fire while waiting; it can then be brought up promptly to the infantry when the latter move forward to the attack.

"Cavalry should then act with greatest speed in order to enable it to fall upon the enemy in flank and rear when he begins to waver.

"In this kind of combat cavalry will gain the wings of the infantry in order to throw themselves against the enemy's flank and thus avoid masking the fire of their own troops as long as possible. The chief must follow the phases of the combat so as to bring his squadrons promptly to the point where the decisive attack is to be concluded."

### III.

The considerable changes which have occurred in the terrain during the last half-century will nearly everywhere impede the deployment and action of cavalry masses. Trade and agriculture have developed in an extraordinary manner, estates have been divided up, buildings of all kinds cover plains formerly bare; while canals, railroads, and enclosures of every kind present so many obstacles to the march of mounted troops. A regiment of cavalry can hardly manœuvre where formerly great cavalry combats have taken place. Hence the indispensable necessity of reconnoitring the terrain before charging is imposed more stringently than ever.

Every one knows that at Waterloo the impulse of the French cavalry was broken at the sunken road of Ohain, the existence of which they were ignorant. Later at Sadowa, towards the end of the fight, the second division of Austrian light cavalry, who were ordered to watch the bridges over the Elbe, attempted to stop a Prussian brigade which threatened to cut off

their retreat. Lieutenant-Colonel Wichmann, who commanded this brigade composed of hussars and dragoons, deployed his hussars in the first line and placed his dragoons in rear of the left in column of squadrons at full distance. He committed the fault of not reconnoitring the ground in his front and after he had thrown forward his first regiment soon saw it fall into a kind of ravine where it was entirely destroyed before the dragoons even had time to succor it.

In 1870, at the battle of Woerth, the cuirassiers of the Michel Brigade and those of the Bonnemain Division attempted in vain to charge over ground covered with vines and hop-gardens and cut up by numerous ditches. This fearless cavalry, whirling about the securely sheltered Prussian infantry, were riddled with bullets and forced to retire after having met with serious losses and without producing any appreciable result as a consequence of their heroic devotion. Certainly no one would have ordered these charges if a reconnaissance of the ground had been made beforehand. Under such conditions they were condemned to failure in advance.

Moreover the advantages which cavalry loses in cut-up and varied ground the adverse infantry gains. The latter find shelter in small accidents of the surface and as their improved armament allows them to fire a large number of bullets in a few minutes, we must admit that the leading of cavalry has become extremely difficult and that under present conditions the attack upon isolated infantry will demand much prudence. And we must not lose sight of the fact that infantry is generally supported by a numerous artillery. Without forgetting the difficulty which this latter arm experiences in estimating distances quickly and assuring accuracy of aim against rapidly advancing cavalry, we must remember that the excellent material with which it is now provided, enables it to do much better execution than in times past. Being able to shoot with sufficient accuracy up to 4000 metres or even to 5000 metres, and, as in the case of French shrapnel, with projectiles giving a beaten space, oval in shape, having an average of 60 metres in width by 350 to 400 metres in depth,\* taking the result of a series of shots fired under the same conditions of pointing and regulation of fuse, it is clear that the artillery will attach less importance to an exact estimate of distance. Artillery can be put in battery far more rapidly than formerly and can in a moment cover the ground with fragments of shell, or balls from its shrapnel.

The difficulties of the attack upon infantry supported by artillery are then considerable and will require more than ever that cavalry should utilize all cover in order to avoid disastrous effects of fire. It must remain outside the beaten zone and only appear at opportune moments in a formation as thin as possible, dashing forward with greatest speed and retiring again as quickly when the object has been attained.

Such we believe is the general line of conduct to be followed by cavalry on the battle-field of the future.

#### IV.

Finally, the last cause, and the most important one, explaining the dif-

\* Colonel Langlois, *L'Artillerie de Campagne en Liaison avec les autres armes*.

ferent results obtained by cavalry during two very distinct periods, resides in difference of tactics.

Formerly battles were nearly always delivered on comparatively even ground, rarely cut up or covered with obstacles; the entire lines came into collision.

"History shows," writes the author of "The War about Metz," "that in each period of great wars the battle has had its distinctive character. If the transformation has taken place insensibly, it has ended nevertheless by being so complete, from one period to another, that we clearly see certain elements appear as of the first importance until then regarded as entirely secondary.

"In order to discover the fundamental traits which still characterize the battle of to-day, we need go no further back than the time of the Great Frederick. At this epoch fire-tactics of the line were practised for deciding battles and they impressed upon the latter their distinctive character. The two armies were deployed facing each other on great uninterrupted lines, and victory pertained to that one which succeeded in making a gap in his adversary's front, whence he could operate by a turning movement on a portion of the enemy's order of battle.

"At this time infantry had already become the principal arm, the artillery simply served to give more solidity to the lines and on occasion to shake that portion of the enemy's front which they wished to attack.

"Cavalry could however still seize the first rôle if by a victorious charge it succeeded in making the gap of which we have just spoken. Unfortunately, in order not to mask its own infantry, the cavalry was most often obliged to take position on the wings where it found itself faced by the enemy's horse, whom it became necessary to put out of the fight before playing a decisive rôle in the struggle.

"In view of this common character in the battles of Frederick's time, the advantage lay with that army which could manoeuvre best, that is to say, with that one which could move with greatest ease and rapidity without destroying the cohesion of its order of battle.

"One valuable quality of this formation was that which permitted attacking columns to be pushed forward against a point of the enemy's line for the purpose of causing a serious gap there while at the same time the remainder of the troops could be withdrawn, if not entirely at least in great part, beyond reach of the enemy's fire. The most brilliant successes of the Great King were due to the fact that he had an army as skillful at manoeuvring as that of his adversaries was weak in this regard. And although his force was nearly always numerically inferior, he found means of arriving at the point of attack, if not with superior strength, at least with his choicest troops, and thus to assure victory. Hohenfriedberg, Prague, Leuthen exemplify this in a remarkable manner.

"During the last battles of the Seven Years' War, notably in those fought against Russia and in that of Torgau against the Austrians, the character of the struggle changed little by little, approximating gradually to what it was to become during the wars of the First Empire. It was now no longer by breaking through the enemy's line, but by utilizing successively all the

force at their disposal that the adversaries endeavored to bring about the *denouement*.

"In the wars of the Revolution, the battle took on a transitional character intermediate between that which it possessed in the time of Frederick and that which Napoleon afterwards rendered classical. The infantry was divided into separate masses, divisions, brigades, battalions, and acquired by this means a facility of manœuvring and an independence of action entirely unsuspected until then. Thanks to this division of the troops they could engage on ground not long before regarded as impracticable, and once established there, to admit large masses of troops under cover of their fire.

"Cavalry lost its importance; however violent, however fortunate might be its shock, it could not decide a victory as at Hohenfriedberg. At best it could only succeed in routing one or more battalions, and its own success threw the ranks into such disorder that further pursuit became impracticable.

"By way of compensation, the artillery gained in importance as the cavalry lost. The long range of the field gun enabled its projectiles to strike the enemy's masses from a great distance with a force which carried havoc through all his ranks. Finally the mobility which it had acquired permitted the artillery henceforth to pass rapidly to any point where its presence was deemed necessary.

"Deep masses of infantry, from which new bodies (skirmishers) are continually thrown out to advance in line, replace the deployed front of the old order of battle. The struggles are of longer duration and victory pertains to that one who can oppose fresh troops to the exhausted soldiers of his adversary. This delay in determining the issue is due chiefly to the imperfection of the infantry musket, but results also from the fact that the reserves are withdrawn beyond artillery range, yet retained sufficiently near to be effective on the theatre of action.

"It had become a principle that he who would win must have the last fresh reserve, hence numerical superiority most often decided the fate of battles. The creation of armies as numerous as possible became from that time the object of military organization and the leading of these enormous masses on the terrain that of the men of war.

"That one of the two adversaries who could best sustain this double task could count not only on obtaining a passing success but of remaining victorious to the end of the struggle.

"For organizing great armies as for leading them Napoleon was master. Hence victory remained with his eagles until combined Europe came to combat him with his own weapons, put on foot more soldiers than he could bring together, and learned to preserve this superiority on the field of battle."

To-day the improvements in arms have brought us back to the fire of the lines of Frederick's time; these latter however are no longer in a solid formation, though we cannot break them at points of the combat without suffering disadvantage. When one of these points has come definitely into the power of the assailant, he dominates from there with his long-range

weapons such a great extent of his adversary's line of battle that the latter can no longer maintain his position and must fall back to another or abandon the field entirely.

The battle of to-day approximates to that of Frederick's time for a purely local success may become decisive, and in order to obtain this success it is no longer necessary to employ the full force at command nor to fight on the whole extent of front. On the other hand, the present organization of armies places them in a measure as well, and better perhaps, with those of the time of Napoleon by reason of sending new troops continually into the fight.

Great modern battles retain this common character with those of the commencement of the century; they are only gained or lost after putting into action the last combatants that can be led to the points whose possession is disputed.

Since the important improvements which arms have received, but two entirely decisive battles, properly speaking, have been fought. The first, that of Koeniggratz, presents in a most striking manner the character which we have just explained. The position first occupied by the Austrians became untenable when Chlum and its surroundings came definitely into the power of the Prussians and this great result was due almost exclusively to the partial action at this particular point. Which was moreover only an artillery combat so to speak, notably on the side of the First Prussian Army, and to such an extent that three-fourths of that army influenced the result only indirectly by its presence. Chlum once taken the Austrians fell back to the positions at first occupied by their reserves, which in turn became untenable and had to be abandoned when the Elbe Army had rendered itself master of Probus.

In order to obtain this second result they engaged not more than an inconsiderable portion of the first and second armies.

After this the terrain no longer offered favorable positions in rear to the Austrians and the morale of their troops was so much destroyed that they were incapable of continuing the struggle. A good third of their force had not fought at all or had only been engaged in a very slight manner.

The second great battle of which we wish to speak was that of the 18th of August near Metz. It presents the same character in a manner less clear perhaps, but distinct enough, however, for us to enter into precise details.

The plan of the Germans was to attack the French so as to throw them back on Metz, while all the efforts of Marshal Bazaine tended towards maintaining possession of the only road which still kept him in communication with the rest of France. Hence it was exclusively the right wing of the French which became the objective of the German attack, and the taking of St. Privat decided the fate of the day. If they fought along the rest of the line it was because the assailants wished it; there was no pressing necessity for doing so.

To sum up then, our modern battles resemble at once those of the times of Frederick and of Napoleon. As in the time of Frederick a success at a particular point of the front may decide a victory; as in that of Napoleon, the issue of the struggle is certain only after bringing upon the decisive point all the troops which can be placed in line there.

The points of resemblance between modern battles and those of Frederick and Napoleon established, let us return to the First Empire and see what took place during this period.

We have already noticed the appearance of skirmishers in the XVIII. century during the War of Independence in America and the French Revolution in Europe. A new kind of combat had come into being, the combat of localities. Thus at Jemappes (1792) we see the villages of Cuesmes, Ciply, Quaregnon, Jemappes and Flenu occupied by Austrian posts and covered by skirmishers.

Under the Empire the combat of localities became greatly extended and brought about the first dividing up of the infantry lines. They sought to take advantage of ground. Hence we can say that the battles of 1813, 1814, 1815 were only localized combats.

The battle of Waterloo particularly was but a succession of partial attacks for the capture of Hougomont, La Haie Sainte, Papelotte, Smohain and Plancenois, followed by a general charge of French cavalry against the English centre, 40 squadrons disposed in four lines of a brigade each. This is the first phase.

In the second phase, which occurred as soon as the English and German cavalry regiments had been destroyed, we see form in line what remained of the cavalry which had taken part in the first attack, besides more than 3000 of Kellermann's cuirassiers and 2000 horse-grenadiers and dragoons of the Guard. It was then with 80 squadrons that Ney fell upon the English!

Under Napoleon also cavalry ceased to be placed invariably on the wings as before, and he put in practice the more intelligent idea of assembling it on points where it could be of greatest use. But one principle—and an eternally true one—was observed in its employment; he sought to preserve its great offensive power and for that purpose placed it in such a position that it could enter promptly into action.

By reason of this wise appreciation of things, nothing was fixed in the allotment of cavalry to the various subdivisions of the army. It was the rule however that each army corps should have cavalry with it and a general reserve was formed composed of a considerable number of regiments. But the corps cavalry, whose strength varied at the beginning of the fight from a division to a brigade, found itself reinforced by one or several brigades. Sometimes also the cavalry was taken entirely away in order to place it where it was most needed.

In the same way the place and strength of the reserve was subject to change during battle. An enormous mass of squadrons were united, in appearance, under the orders of Murat, but this command was only fictitious, very temporary, and often limited to the single instance necessary for executing, as at Eylau for example, a charge of 80 squadrons—an irresistible torrent of men and horses which was to break down all obstacles.

In short, during the period of the First Empire the French cavalry was distributed and grouped, according to circumstances and the successive phases of the battle, on the wings and in rear of the army corps. The reserve was sent in at points where it was necessary to strike a decisive blow (General de Bonie).

In modern wars, having regard to the enormous effectives present, the Napoleonic tactics are carried out and there can be no other, because not only are the ancient battle-fields no longer found, but besides, no general would seek them.

Hence we see in 1850, 1866, 1870 and 1877 that localized combats have become the rule, the battle has degenerated into a series of struggles at different points leading to a great dissemination of force and a splitting up of the lines. To be convinced of this it is only necessary to recall the infantry battle tactics of to-day and the subdivision which the battalions undergo during action when advancing to the attack of a position.

In support of what we have advanced above we may cite the battle of Magenta (1859) which from a tactical point of view was only an example of the passage of a river, the Tessin, and the attack upon three villages, Turbigo, Buffalora and Magenta; and that of Koeniggratz (1866), where the whole action developed about a few villages and clumps of wood.

Likewise in 1870 the battle of Gravelotte was decided by the taking of St. Privat, but they still fought for the possession of Roncourt, Amanvillers (French centre), Montigny-la-Grange and the farms l'Envie, la Folie, Leipsic and Moscou, which were occupied by the French left and finally for the village of Rozereuilles.

Under these conditions, how can cavalry be made to act in great masses? Will the occasion for launching a number of squadrons be presented again? Would not these squadrons be decimated before arriving at the enemy's lines? Let us see what history teaches in this regard.

At Woerth after the Germans had seized Elsasshausen, two brigades of French cavalry sought to retake the village and reestablish communications with the centre and right wing. The Prussian infantry fire broke up this attack and two regiments of cuirassiers were nearly annihilated. The heroic charge of the Marguerite division at Sedan produced no greater result.

At Beaumont, August 20th, a remarkable circumstance occurred; the 10th company of the 27th Regiment of Prussian infantry awaited, without firing, the charge of the 5th cuirassiers who had taken position to the north of Mouzon.

When the French cavalry reached this infantry, a fire at will burst out at point blank range causing frightful ravages in the ranks of the cuirassiers. Colonel Contenson was mortally wounded at fifteen paces from the line of skirmishers. Several other officers were either killed or wounded, and in short the charge was repulsed with a loss of 11 officers, 109 men and 126 horses.

*(To be continued.)*

## Military Notes.

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### LORD ROBERTS ON MAGAZINE RIFLES AND SMOKELESS POWDER.

CAPTAIN H. V. COX, Indian Staff Corps, Deputy-Assistant Adjutant-General for Musketry, Imperial Service Troops, delivered a lecture on July 21st at the United Service Institution, Simla, on the "Magazine Rifles of European Armies and their probable effect in combination with Smokeless Powder upon Tactics." Lord Roberts, the Commander-in-Chief, presided.

The Commander-in-Chief, in his opening remarks, said: In introducing Captain Cox to you, I will, with your permission, say a few words on the subject of the lecture with which he is about to favor us. As you are doubtless aware, the fighting efficiency of infantry depends on its being able to pour an accurate and well-directed fire, and at the decisive moment of a conflict, an extremely rapid fire, on the force to which it is opposed. The magazine rifle, therefore, should enable a soldier to carry out this duty with much greater certainty and destructive effect than heretofore, provided only that he has been thoroughly trained in peace time to use it effectively. It must be remembered that the more perfect the tool, the more skill is required from the workman who uses it; and unless fire discipline is most carefully inculcated and enforced, the rapidity of fire which the magazine rifle admits of will undoubtedly lead to a waste of ammunition. Even when the magazine is not in use, the much longer range of the new weapon will rather tend to a similar result. The temptation to resort to long-range fire will be much greater than before, and for such fire to be really efficacious, it should only be made use of under the orders of some duly qualified authority, who can judge the distance correctly and keep the men whom he is directing under strict control. Unfortunately, no statistics are available to show the amount of ammunition expended on different sides in the principal engagements of the Peninsular and Napoleonic wars. But I am inclined to think that the proportion of casualties to the number of rounds expended has not increased since that period to the extent which might have been anticipated from the improvement that has taken place in the infantry soldier's fire-arm. On the contrary, it would not surprise me to find that, in more recent wars, the proportion of casualties has actually diminished for the following reasons. First, the greater facility in loading, which is apt to generate hasty firing; secondly, the tendency to make use of long-range fire, whether it is likely to be effective or not; and thirdly, the comparatively short time available in which to train the soldier of the present day in marksmanship and fire discipline. In confirmation of this

view the following figures may be quoted. The loss in killed and wounded at Marengo was one fourth of the total number of combatants engaged; at Austerlitz, one-seventh; at Jena, one-sixth; at Eylau, Salamanca and Borodino, one-third; and at the siege of Delhi, in 1857, about the same. At Waterloo the English loss was one-fifth, that of the French being unknown up to this time. The infantry were all armed with smooth-bore muskets. The first great war in which rifles were in general use on both sides was that between France and Austria in 1859. Ammunition was very freely expended during this war, and yet at Magenta and Solferino the loss was only one-eleventh of the total forces engaged. At Königgratz, in 1866, the Prussians were armed with breech-loading and the Austrians with muzzle-loading rifles, the loss being one-fifteenth; and during the Franco-German war, both sides being armed with breech-loaders, the loss at Woerth and Spicheren was one-eighth, and at Gravelotte one-eleventh. It would seem, therefore, that since the introduction of modern rifles the larger quantities of ammunition expended have not produced any commensurate effect. I think, too, it will be found that the better trained and fed the troops are, the less is the average number of rounds required to obtain decisive results. During the war between France and Germany in 1870-71, the 12th German Army Corps fired only an average of some eleven rounds per man throughout the various battles in which it was engaged, while on several occasions, more particularly when the preparatory action of artillery had been neglected, the French, who, we all know were beaten, used up all their available cartridges (from 90 to 108 per man), and had eventually to retire for want of ammunition. Again, during the operations at Plevna in 1877, 160,000 Russians fired ten million rounds, while 70,000 Turks fired no less than fifteen million rounds; the total number of killed and wounded amongst the former being 40,000 and amongst the latter 30,000. Leaving out of account the losses caused by the 200,000 rounds fired by the Russian artillery and the 80,000 rounds fired by Turkish artillery, this gives an average of nearly 360 rifle shots to each casualty. It is impossible to calculate with any exactness the proportion of casualties in action due to the fire of infantry or artillery, or to the sabres of cavalry; but, in view of these figures, and similar ones which might be quoted, it is hardly surprising to learn that the average efficacy of rifle fire, even at short ranges, is estimated at less than one per cent. If British and Native infantry could be so trained as to make it certain that one bullet out of every twenty would hit the object aimed at—and this surely is not very much to ask—they would be five times as efficient as the troops of any Continental Power have yet shown themselves to be. You will perceive, then, how essential it is to our success in war that we should pay unremitting attention in peace time to marksmanship and fire discipline with the magazine rifle. In India it will be our own fault if we do not turn the new arm to the best account. It is particularly incumbent on us to do so, for the army in this country is by no means in excess of our military requirements, and the distance by sea which separates us from our English base would prevent our being able to rely on receiving reinforcements with certainty and rapidity. I will not attempt to discuss the tactical effect which

the introduction of a small-bore magazine rifle and smokeless powder may be expected to produce in future campaigns. This point will be dealt with by the lecturer. I will only remark that in a conflict between approximately equal numbers the advantage would seem rather to lie with the defense, assuming the troops on either side to be equally well trained and disciplined, and an adequate supply of ammunition to be forthcoming. If the average percentage of fire efficacy could be improved to the extent that I imagine to be feasible, it would be almost impossible in daylight to deliver a front attack upon a well-posted enemy without suffering extremely heavy loss, and for this reason it seems not unlikely that night assaults may be more frequently resorted to than heretofore. The manoeuvres at Meerut proved that an attacking force can operate to best advantage by moonlight, which enables the men to see their way and keep touch with each other, while, at the same time, it is not sufficient to define surrounding or distant objects clearly enough to admit of an accurate fire on the part of the defenders. In concluding these introductory remarks, I would again remind you that, as our army is numerically weak, it becomes more necessary for us than for any Continental Power to maintain and increase the fighting efficiency of every soldier serving in its ranks. Our infantry has always been celebrated for the coolness and accuracy of its fire. In the interesting "Memoirs of Baron de Marbot," which have lately been published, that officer, who saw much service in the Peninsula as aide-de-camp to Marshal Masséna and other distinguished French commanders, in discussing the chief causes of Wellington's success in driving the French out of Spain, says:—"In my opinion the principal cause of our reverses, though one which has never been pointed out by any soldier who has written on the Peninsular War, was the immense superiority of the British infantry in accurate shooting; a superiority which arises from their frequent exercise at the targets." If we are careful to maintain the superiority we possessed nearly a century ago and are determined that the marksmanship and fire discipline of every branch of our infantry, whether at home or abroad, shall keep pace with the improvement in the weapon with which it is armed, I feel confident that we shall still be able to hold our own against any enemy we may be called upon to encounter.—*United Service Gazette*.

#### SUBCALIBRE TUBES FOR SEA-COAST GUNS.

(From the *Revue D'Artillerie*, by LIEUT. J. C. BUSH, 5th Artillery.)

Captain Langencheld of the Russian Artillery has conceived the idea of effecting subcalibre fire from sea-coast guns by employing a rapid-fire gun of 57mil. (2.2 in.) calibre as an inner tube. The arrangement which he has thought out for attaching the tube to the interior of the gun has obtained for him the Michel prize on the recommendation of a commission presided over by General Pachevitch. General Pachevitch has published his opinion of the results of the firing experiments in the *Artilleriiskii Journal* for March.

We give a resumé of the essential portions of this paper.

In order to preserve guns of large calibre from being prematurely worn out, the Russian coast artillery, up to the present time, have employed re-

duced charges of one-half at the firing school and limited the number of shots from each piece.

They have thus found it impossible to give firing instruction to the extent desired. These measures were moreover not entirely effective, for the inspection of sea-coast guns made in 1889 showed in fact that even with reduced charges the large calibres experienced considerable erosion.

The question had reached this stage when Captain Langenfeld proposed to the Artillery Board the idea of resorting to a system of firing tubes by employing in certain coast guns the rapid-fire gun of 57 mil. (2.2 in.) recently adopted in Russia.

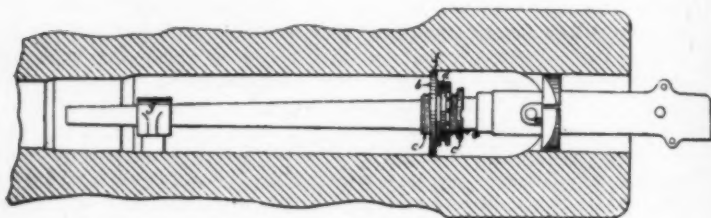


FIG. 1.

The mode of fixing the cannon-tube is represented in general plan by Fig. 1. Various parts are required and these are indicated on this figure by their letters and represented separately in plates 2 to 6.

Each trunnion is enclosed by a collar *a*, (Fig. 2) the rear portion of which is squared and enters a seat in the bed *b* (Fig. 3). This bed, intended to receive the shock of recoil, is fixed in the mortise or breech slot (Krupp system) of the gun. It has the form of a segment of a cylinder whose outline corresponds to that of the slot. The central portion (Fig. 3) of this bed, to the rear, forms a cylinder which fits into that part of the bore in rear of the wedge ferrure and centres the bed. It is bored out to receive the body of the smaller gun. In front of the trunnions is placed a tightening apparatus (Fig. 4) consisting of a collar *c* of steel threaded on the outside and a nut *d*. The interior of the collar forms two parts, the fore-end portion, conical in shape, corresponds to the exterior surface of the gun-tube; the rear end, of a larger diameter, is separated from the other by a projection by means of which the collar abuts against the hoop of the gun-tube.

The nut has notches cut on its outer surface by which the apparatus is tightened up—a special key being provided. In front of the nut is placed a circular supporting plate (Fig. 5) of gun metal, and formed of two parts. It takes support against the front face of the breech slot when the rapid-fire gun is in place.

A chase support *g* (Fig. 6) of bronze, serves to centre the chase and to maintain the muzzle in the direction of the axis of the larger gun during the operation of mounting.

The mounting of the system is performed in the following manner: The tightening apparatus (collar and nut) and the chase support are put in place



Fig. 2.

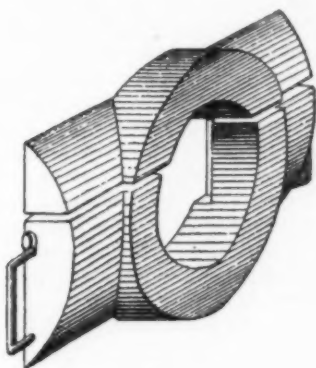


Fig. 3.

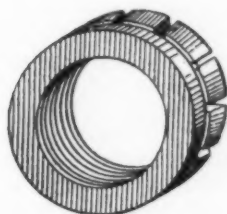
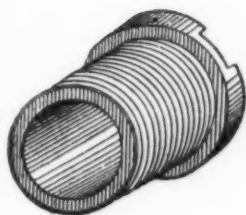


Fig. 4.

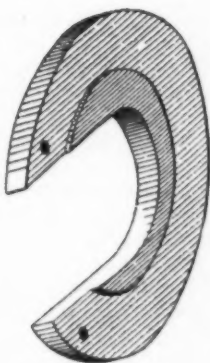
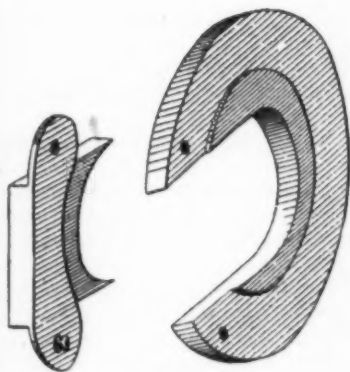


Fig. 5.



Fig. 6.

on the gun. The middle of a lifting chain terminated by trunnion rings is then passed over the hook of the loading crane of the larger gun and the gun-tube raised by this means to the height of the larger and then carefully introduced muzzle foremost into the bore of the first until the trunnions come in contact with the base of the breech. It is then supported at the breech by means of another lifting chain and the trunnion chain removed. The gun-tube is then pushed forward until the trunnions enter the breech-slot. The wedge having been previously removed, the trunnion collars (Fig. 1) are placed upon the trunnions, the bed, in two parts, (Fig. 3) put in position behind the collars and the gun drawn back until the squared ends enter their seats in the bed. Finally the two parts of the circular supporting plate (Fig. 5) are introduced at the side through the breech-slot and the nut screwed up by means of the key against this plate until the whole system is tightly in place.

The 57 mil. gun is thus immovably fixed within the larger gun so as to form with the latter a single piece, the axes of the two corresponding with sufficient accuracy for all practical purposes.

All parts of the apparatus together with the accessories are placed in a wooden box which weighs about 145 kg. (319 lbs.).

The trials took place at the central proving ground at Okhta. They fired 159 shots of which 107 had a charge of 1 kg. .082 (2.38 lbs.).\* This last figure for weight of charge had been chosen by Captain Langencheld so as to cause the table of fire of the 57 mil. gun to correspond with that of the larger gun when using a full charge for distances between 1700 metres (1853 yds.) and 2500 metres (2725 yds.) which are the ones ordinarily shot over against moving targets. The agreement between the two tables was found sufficiently near for practice. It was admitted that the precision of fire was sensibly the same as that of the larger gun when using the half-charge. The charge of 1.082 kg. (2.38 lbs.) produces no erosion in the smaller gun.

The commission formulated the following conclusions regarding the value of this invention :

(a) The idea of subcalibre firing tubes is far from new. About 1860 General Mosolov proposed an apparatus for subcalibre firing for the 15 mil. gun.

In 1873 General Rote presented a plan by which musket bullets could be fired from field guns for instruction in pointing.

Subcalibre firing tubes for position guns have already been adopted in several foreign armies. Thus the French artillery employs a gun of 25 mil. (0.98 in.) firing a leaden projectile, for coast guns of 19 c. (7.46 in.) and 24 c. (9.4 in.).

The German artillery has adopted subcalibre tubes for all guns above 12.5c. (4.9 in.). They employ a subcalibre tube of 37 mil. for coast guns and a musket-barrel for position guns. In the Austrian artillery they use a tube of about 25 mil. (0.98 in.). In the Italian artillery the coast guns of 24c. (9.4 in.) and 32c. (12.5 in.) have a firing tube of 75 mil. (2.9 in.) calibre.

\* This full charge of the 57 mil. gun is 1.200 kg. (2.64 lbs.). It impresses upon a projectile weighing 9.720 kg. (5.98 lbs.) an initial velocity of about 640 metres (697.6 yds.).

(b) The system thought out by Captain Langenfeld has worked well and shows sufficient strength to resist fire-action.

(c) This subcalibre gun of 57 mil. has the advantage over those adopted in foreign services of being capable of utilization in time of war for coast defense.

(d) The unity of the tables of fire sought after by the inventor constitutes but little appreciable advantage considering that it suffices to know the method of employment of any one table in order to use all other similar tables.

Examining subsequently the advantages which the Russian artillery would receive by the adoption of this system, the Commission observed that :

(a) The employment of the subcalibre tube in guns of large calibre will assure the good preservation of the latter.

(b) It will permit the greatest amount of instruction at the firing school.

(c) From the point of view of instruction the subcalibre tube of 57 mil. is superior to those adopted in the French, Italian, Austrian and German artilleries.

(d) Finally, the plan proposed for the gun, model 1877, can by means of certain modifications be applied equally well to that of 1867.

Consequently the Commission consider the invention as suitable for adoption in the Russian artillery.

#### PROFESSOR HEBLER ON OGIVAL-HEADED BULLETS.

Professor Hebler, of Zurich, the well-known expert on small-bore rifles, contributes to the *Allgemeine Schweizerische Militär-Zeitung* an important article on "The employment of a more suitable ogival head for projectiles, and the advantages to be derived therefrom. All projectiles nowadays are ogival-headed, but sufficient importance, in the Professor's opinion, has not been paid to the correct shaping of the head. Incidentally he mentions that the English small-bore bullet has a far longer point than that given to any other rifle bullet; but, owing to its incorrect shape, its efficiency is not nearly as great as it might be. The Professor takes as a fair standard for comparison the bullet of the German small-bore rifle, 1888 pattern, which has a total length of 32 mm., and claims the following advantages for the improved ogival-headed bullet which he himself suggests:—With the new bullet—which is of the same length as the German pattern—the weight is reduced from 14.5 grammes to 13 grammes, thus reducing the total weight of the cartridge from 27.5 to 26 grammes, whilst the initial velocity is increased from 640 to 670 metres. At the same time the maximum pressure in the bore is reduced from 3300 to 2800 atmospheres. Fired against an object 1.7 metre high, the beaten zone at 1000 metres is 68 metres as against 40 metres, and at 2500 metres 14 metres as against 7 metres for the standard German bullet. The new pattern bullet, in spite of its lessened weight, further has a much greater remaining velocity at long ranges, and, consequently, retains greater *vis viva*—e. g., it is claimed that at 1000 metres, its penetration into deal is 34 cm., and at 2500 metres 11 cm., as against 21 cm. and 6 cm. respectively.

As regards deflection, with a moderate side wind blowing the new bullet compares very favorably with the old. With a side wind of 5 metres a second, the lateral deviation of the bullet at 1000 metres is 1.7 metres, and at 2500 metres 23 metres, whereas the German bullet under similar conditions would show a deflection of 2.5 metres and 43 metres respectively. It is still further claimed that the kick of the rifle is less. Summing up the ballistic efficiency or "goodness" of the two patterns, Professor Hebler puts that of the German pattern at 474, and that of his own at 784. If these data are to be relied upon it is clear that one of the most important questions to be studied is that of giving the bullets of modern rifles the most favorably shaped ogival head possible, as this alone would raise the efficiency of the weapon by at least 65 per cent. The Professor, who at one time thought that the limit of small bores had been reached, is now a strong advocate for the reduction of the bore of military rifles to 5 mm. (.197-inch). The following particulars of the relative "goodness" of rifles of various bores are interesting as showing the increased efficiency which he considers to have been already gained, or which it is still possible to attain to.

Taking the "goodness" of the German 11 mm. rifle, 1871 pattern, at 100, the present rifle, 1888 pattern, stands at 474, or with the best possible shaped bullet at 784. By reducing the bore to 5 mm. its "goodness" with the ordinary shaped bullet is 1429; with a bullet having a head 12 mm. long this is increased to 2032; with one 15 mm. long it equals 2381, and with the best possible shaped ogival head 2522. In other words, the 5 mm. rifle is capable of being made twenty-five times as effective as the 1871 pattern, and five times more effective than the present German rifle.—*United Service Gazette*.

## Reviews and Exchanges.

### Professional Papers Royal Engineers.\*

**T**HIS entire issue is devoted to the subject of sanitary engineering, being a monograph prepared by Major Moore, Royal Engineers, to meet a need for concise information appreciated when preparing lectures to be delivered before his classes at the School of Military Engineering at Chatham. The subject is systematically treated, and the book is well supplied with illustrations. A copious index adds to its value. The work is practical rather than theoretical, and bears the marks of careful study. It supplies information which should be known to all officers charged with the duty of designing the barracks and quarters at the new Posts intended for permanent occupation in the settled parts of the country. The policy of concentrating our scattered garrisons into large Posts has assimilated our system more nearly to that of Europe, and this book meets a need in our service which will be appreciated by officers charged with directing and supervising the sanitary arrangements.

H. L. A.

### Ordnance and Gunnery, U. S. M. A.†

This work, prepared by Capt. Henry Metcalfe, Ord. Dept., U. S. Army, first appeared in two parts both from the U. S. M. A. Press, West Point, N. Y. Part I., in 1889, gave chapters I. to XVIII. inclusive, and Part II., in 1891, Chapters XIX. to XXX. inclusive. The present edition embodies both parts, with but few material changes.

A notable feature is the system of paging. The page-numbers begin anew for each chapter, whose number and heading also appear at the top of the page. This method, intended to facilitate revision, permits any chapter to be rewritten without disturbing the paging of any other chapter. Its importance is apparent in a rapidly changing subject.

The text is well printed in clear type of good size, with headings in bold-faced type which gives them great prominence.

An index supplements the table of contents, which gives merely the numbers and headings of chapters.

The accompanying plates are well gotten up and copiously illustrate the text.

The subject of explosives is quite fully treated in chapters:

- |                                |                                |
|--------------------------------|--------------------------------|
| II. Explosive Agents.          | VIII. Phenomena of Conversion. |
| III. Ingredients of Gunpowder. | XIII. History of Gunpowder     |
| IV. Manufacture of Gunpowder.  | XIV. High Explosives.          |

The distinction between combustion and detonation is based on the amplitude and velocity of molecular vibrations, which seems intangible for the general reader, to whom

\**Professional Papers Royal Engineers.* Occasional Papers. Vol. XVII, 1891.

†*Ordnance and Gunnery, U. S. M. A.* Captain Henry Metcalfe, Ordnance Dept., U. S. A., New York: John Wiley & Sons. 1891.

the language is otherwise well adapted. A paragraph has been inserted on "Ammonium Nitrate" and one on "New Smokeless Powder," since the first edition was published.

Ballistic machines are treated in chapters :

VI. Velocimeters.

VII. Pressure Gauges.

which also give outlines of several methods for determining the variable pressure in the bore indirectly from measured variations in the energy of the projectile or of the recoiling gun. The marked superiority of Noble's crusher gauge for pressures over that of Rodman is fully recognized (VII. p. 5). A neat and simple demonstration shows the advantage of "a preliminary deformation of the specimen to nearly the total extent that is expected" (VII. p. 7). This proof may also be utilized to show the superiority of copper over softer metals as a material for specimens to be deformed. A description of the West Point target for measuring the velocities of small-arm projectiles has been inserted (VI).

Interior Ballistics is treated at length in chapters :

V. Interior Ballistics.

X. Combustion of Gunpowder in Air.

IX. Noble and Abel's Experiments.

XI. Combustion of Gunpowder in the Gun.

XII. Sarrau's Formulæ for Interior Ballistics.

A simple formula for the varying pressure in the gun is deduced from Noble and Abel's experiments under Mariotte's law for constant temperature. From this is deduced a formula for the work done by this pressure, Chap. IX. Eq. (7), (8), (9), Chap. X. Eq. (7). These are instructive, and easy to follow and comprehend.

Sarrau's formulæ for muzzle-velocity and for maximum internal pressure are assumed without deduction owing to lack of space. In their practical use the determination of the constants is complicated and not adapted to the general reader. The student will also have difficulty on page 3, Chap. XI, where Eq. (1) is deduced treating  $x$  as a volume, and then in differentiating to obtain Eq. (2) and (3),  $x$  is treated as a line. This is equivalent to omitting a constant factor, the area of cross-section of the bore, from the second members of Eq. (2) and (3). In deducing Eq. (4) and (5) from these,  $\delta$  is substituted for  $\frac{dw'}{dt}$  thus again omitting a constant factor. (See foot-note Chap.

X, page 2, where complete value is given.) It is only the vagueness of the general conclusions, drawn without integration, that avoids serious error in them.

The powder coefficients are interesting. 1st. That of "mildness or progressiveness" (Chap. XI., page 19), obtained by dividing the mean effective pressure by the measured maximum pressure. Neglecting force expended on friction and rotary motion it measures the uniformity of pressure as the projectile moves. 2d. That "of economy or efficiency," *i. e.*, the muzzle energy per pound of powder charge. 3d. The general coefficient, which is the product of the other two, and is nearly constant with the same gun, projectile, and kind of powder, as the weight of charge is varied. Thus in the 7-inch B. L. howitzer a variation of weight of charge gave to the same projectile muzzle velocities of 840 and 1093 f. s., and to this coefficient values 27.7 and 27.3 respectively. From this the constant  $\pi$  is deduced by aid of the "principle of similitude" and Sarrau's formulæ (Chap. XII, page 29).

The Ferrous Metals are simply and comprehensively treated in

Chapter XV. Metallurgy.

which evinces thorough revision, since the first edition was published, by a great number of minor changes. The special alloys *spiegel*, etc., are differently classified, and a description of the rolling of armor plate has been inserted.

Exterior Ballistics is introduced in Chap. XVI. Projectiles, where preliminary

consideration is given to the resistance of the air. The subject is then prettily developed by Niven's method in

#### Chapter XX. Exterior Ballistics.

This method simplifies the demonstrations, but assumes successive arcs of the trajectory to be each coincident with its chord, and except for very flat trajectories, is either very laborious from the number of arcs separately computed, or lacks accuracy. The method of Siacci as given by Capt. J. M. Ingalls is less simple to demonstrate but is far superior for use, and with the labor saving device of Capt. Scipione of Italy has attained accuracy with very little labor. Ingalls' latest tables embodying these obvious advantages have lately been adopted for use of Cadets at the U. S. M. A.

Exterior Ballistics is concluded by a very pretty discussion in

#### Chapter XXX. Accuracy of Fire.

to comprehend which readily the student should be already familiar with the theory of probability. The author refers for fundamental demonstration to "The Accuracy and Probability of Fire" by Glennon of the Navy.

Ballistics of Penetration as far as relates to armor-plate is treated in Chapter XVI. Projectiles, where are given Very's and Weaver's formulæ, with others.

The theory of stresses and strains in guns is covered by

#### Chapter XIX. Gun Construction.

in which the first twenty pages are written on the older basis of Barlow's law, but the rest of the chapter—added since the first edition was published—is an elegant discussion of the "Elastic Strength of Guns" by Captain Bruff. It contains Crozier's beautiful deduction of the fundamental principles supplemented by a discussion of the strains and stresses of a single cylinder and those of two cylinders united by shrinkage into one. This treatment is worthy of careful study and is much simpler than that of the Russian Colonel Pashkevitch as translated by Lieutenant Bliss.

The details of fabrication of projectiles are given at length, but the corresponding details for fabrication of cannon have been omitted probably from lack of space.

The work, while not free from defects, contains much that is valuable both to the military student and to the general reader.

H. H. LUDLOW.

Washington Barracks, D. C., October 6, 1892.

1st Lieut. 3d Artillery.

### The Transactions of the Second Annual Meeting of the Association of Military Surgeons of the National Guard of the United States.\*

Less than one year ago, about fifty surgeons of the National Guard, representing fifteen States, met in Chicago and organized the Association of Military Surgeons of the National Guard of the United States.

The first annual meeting was held in St. Louis, Mo., on the 19th, 20th and 21st of April last with a membership of 200, a healthy growth, which it is to be hoped will continue until it contains every one of the 500 medical officers connected with the National Guard.

The transactions were very interesting and instructive, and were briefly as follows: The convention was called to order by Lieut.-Colonel E. Chancellor, and opened with prayer by the Rev. Jno. Snyder, D.D. Colonel Chancellor then introduced successively, Governor Francis of Missouri, who delivered the address of welcome on behalf of the Missouri National Guard, and Doctor Prewitt, President of the

\* *The Transactions of the Second Annual Meeting of the Association of Military Surgeons of the National Guard of the United States.* St. Louis: Bickel & Co. 1892.

State Medical Society, who delivered the address of welcome on behalf of the medical profession, and Hon. Noonan, mayor of St. Louis, who delivered the address of welcome to the city of St. Louis.

Lieut.-Colonel Charles R. Greenleaf, Deputy Surgeon-General, U. S. Army, was then introduced, and addressed the Association on "The Practical Duties of an Army Surgeon in the Field, During Time of War"; he expressed the regrets of the Surgeon-General of the Army, whose representative he was, at not being able to be present, and of his desire to cooperate with and assist them in every way in his power and that by permission of the Hon. Secretary of War he was enabled to exhibit a complete field equipment of the hospital corps of the U. S. Army which had recently been adopted, and had detailed Major John Van R. Hoff, commanding the company of instruction, with a detachment of his men, to give them an object lesson in the new drill of the corps. Colonel Greenleaf's address was a masterly one, replete with practical ideas and suggestions, and his varied and extensive experience during the late war gave them the weight of authority.

The next address was delivered by Lieut. Angelo Festorrazzi, of the N. G. of Alabama, who responded on behalf of the Association, expressing hearty appreciation of the courtesies and hospitality so universally extended them by the people of St. Louis, in a graceful and polished speech.

Colonel Chancellor then introduced the President, Gen. Nicholas Senn, of Chicago, whose subject was, "The Mission of the Association of the Military Surgeons of the National Guard of the United States." General Senn is not only one of our best surgeons, but he is a profound thinker and an excellent writer besides, as his address amply proved; briefly outlined, some of the work which he hopes to see accomplished in the near future is as follows: [1] State Association of Military Surgeons—The reason why these should be formed in addition to a National Association is because the extent of our territory is so great that we can hardly expect an attendance of more than 150 or 200 at any one of the annual meetings. The absent members will read the transactions, but in order to become infused with the stimulus for work it is necessary to be present at the meetings, take part in the proceedings and come in personal contact with the members. The actual work must be done nearer home, at shorter intervals, and in smaller meetings. Being nearer home they could be held oftener, say three times a year, once just before encampment, at which the work during camp life should be thoroughly planned. Litter drill, first aid to the wounded, camp sanitation and other matters pertaining to the welfare, usefulness and happiness of the civilian soldier, should be freely and thoroughly discussed. Each one of these should be represented at the annual meeting of the National Association, and the State should defray transportation and actual expenses of the delegates attending these meetings. [2] Appointments should be by Competitive Examination—In most of the States the appointment of military surgeons is virtually in the hands of the regimental commander. Personal friendship, political influence and social qualifications have often been more weighty in securing a commission than a thorough knowledge of the art and science of medicine and surgery and other qualifications necessary to make a good military surgeon. This is certainly not as it should be. The appointment should be made as in the regular army, by competitive examination conducted by a board of medical officers. [3] Medical Corps—By establishing a Medical Corps in each State, under the supervision of the Surgeon-General or a Medical Director who could detail the medical officers for duty as location and other circumstances would permit, would obviate the present method of placing military surgeons on duty with their organizations in localities much nearer the home of another colleague than their own, making it necessary to travel unnecessary distances to supply the command with medical aid.

[4] The Uniform of National Guard Surgeons should be like that of surgeons of the regular army. [5] There should be a Military Medical School—West Point makes ample provision for the army officer's theoretical and practical training, but none for the medical officer, though all the countries of the Old World have excellent military medical schools. A four to six months' post graduate course every five years at such an institution by the older surgeons of the regular army would do more than anything else to stimulate an interest in their profession, and prevent their taking up some such study as natural history in order to provide occupation for their leisure time. In this last point General Senn but voices the opinion of the entire medical corps of the regular army, it is what they have been talking of and hoping for, for years past. [6] An International Congress of Military Surgeons should be held during the Columbian Exposition, and in the same city.

General Senn concluded his address by thanking the Association for the honor they had conferred upon him in electing him their first president, and then proceeded with the regular order of business.

During the afternoon session of the first day, Captain Charles B. Ewing, Assistant Surgeon, U. S. A., read a very interesting paper on "The Wounded of the Wounded Knee Battle-Field," with remarks on wounds produced by bullets of large and small calibre, with map illustrating the position of the troops and Indians at the time. Captain Ewing can fight as well as use a lancet, for when Captain Edgerly's troop galloped past him on the battle-field, seeing a horse in the troop without a rider, he mounted it and rode with the troop for three miles, having procured a carbine and ammunition before mounting the horse.

The following excellent papers were read in order given: "The Primary Dressing of Fractures," by Scott Helm, Brigadier-General and Surgeon-General National Guard Arizona; "Sanitary Duties and Rights of Medical Officers, as Affecting their Relations with the Commanders of the Line," by Major A. C. Girard, Surgeon, U. S. A.; "Some Notes on Military Sanitary Organization," by John Van R. Hoff, Major and Surgeon, U. S. A.; "Some Needs of Our National Guard," by Major L. C. Carr, Surgeon, Ohio National Guard; "First Aid to the Wounded," by Geo. Halley, Major and Surgeon, National Guard, Missouri; "Is it expedient to have a physical examination of men before enlisting them as State Troops?" by H. L. Burrell, Lieutenant-Colonel and Medical Director, 1st Brigade, M. V. M.; "The Sanitation of Military Camps," by Lieutenant-Colonel C. M. Woodward, Surgeon-General Michigan S. T.; "The Treatment of Wounds from the Aspect of Germ Infection," by C. B. Ewing, Captain and Assistant Surgeon U. S. A.; "Pride and Prejudice—Tenting on the old camp ground," by C. L. Lindley, Captain and Assistant Surgeon, 12th Infantry, National Guard, State of New York; "Camp Reports," by Jno. B. Edwards, Major and Surgeon, 3d Infantry, National Guard, Wisconsin, then followed a "Biographical Sketch of the late Colonel Fred. L. Matthews, Surgeon-General National Guard, Illinois, by Fred. W. Byers, Major and Surgeon, Wisconsin; National Guard; Colonel Matthews had been recording secretary of the National Association.

A very interesting surgical clinic was held by General Senn at the City Hospital in St. Louis in the morning of the second day's session, during which he performed resection of the knee joint, amputation of thigh, lower third, etc., lecturing upon and explaining each step of the operation as he proceeded, the afternoon session of the same day was occupied in witnessing Major Hoff drill the Hospital Corps, U. S. A., in litter drill, first aid, etc., and inspecting the field equipment of the Hospital Corps. Major Hoff was highly complimented by those present upon the thorough manner in which his detachment was drilled and instructed in every respect.

W. W. R. F.

## Interior Ballistics.\*

This is a translation from the Russian by 1st Lieutenant Tasker H. Bliss, First Artillery, aide-de-camp to the Major-General commanding the army. It is the second issue of the series of technical artillery literature that the War Department has recently undertaken to publish.

Circular A, which was noticed in the July number of this JOURNAL, is, like this, a translation by Lieutenant Bliss from the Russian. In Circular A we have a clear and progressive treatment of the subject of the resistance of guns to rupture. In the present publication we have placed before us a subject which is the natural sequence of first and by the same author. The two circulars present in an admirable way the subjective and objective sides of the gun question—the laws controlling the action of "the spirit of artillery" and the principles of gun engineering that doth hedge it in.

The treatise now under notice is marked by the same close step by step reasoning and full treatment by the author, and by the same limpid style of the translator, that characterized Circular A. The author passes by easy stages from the simple ultimate principles of powder gases and their action to the final application in the formulæ for designing guns.

The impression made upon one in reading these publications, is, that they are, both, well fitted to serve as text books in an advanced artillery course of instruction.

The scope of the circular B is fully indicated by the following table of contents :

I.—COMBUSTION OF POWDER AND THE PROPERTIES OF THE PRODUCTS OF ITS DECOMPOSITION.

II.—THE EQUATION OF MOTION OF THE PROJECTILE IN THE GUN; THE FUNDAMENTAL LAWS OF THERMODYNAMICS.

Application of the laws of thermodynamics to the motion of a projectile in the bore of a gun.

III.—FORMULA FOR DESIGNING GUNS.

Problem presented in the designing of guns; modulus of powder; numerical example (Pars. 30 and 33.)

IV.—INFLUENCE OF CIRCUMSTANCES NOT TAKEN INTO CONSIDERATION IN THE PRECEDING CHAPTERS.

V.—THE STATICAL MEASUREMENT OF PRESSURE.

VI.—THE DYNAMICAL DETERMINATION OF PRESSURE.

The development of smokeless powders has, of course, of late, left the subject of interior ballistics in a state of suspension in so far as these new powders are concerned. The problem before ballisticians at present is, to determine anew all factors influenced by the force of powder, its specific gravity, form of grain, etc., that is,  $f, \delta, \mu, \lambda, \tau$ , etc.

When a new powder shall have been definitely decided upon, and these factors shall have been carefully established by experiment, interior ballistics will recover its position of usefulness, which, just now, appears to be in danger of being somewhat lowered. The experiments and writings of Mr. J. A. Longridge† of England, and such work as that of Mr. L. V. Benét as described by him in the July number of *The Journal of the United States Artillery*,‡ give promise that this attainment is not far distant.

\* *Artillery Circular B*, May 25, 1892. Interior Ballistics. By Colonel Pashkiewitch. Professor at the Michael Academy, St. Petersburg, Russia. Translated by 1st Lieut. Tasker H. Bliss, 1st Artillery, A. D. C.

† See "The Artillery of the Future and the New Powders." By J. A. Longridge.

‡ "A Study of the Effects of Smokeless Powder in a 57-m.m. gun."

Artillery officers will renew their thanks to the War Department and to Lieutenant Bliss for placing in their hands so valuable a professional work as Circular B, supplementing, as it does, that already presented in Circular A. E. M. W.

### Index to the Literature of Explosives, Part II.\*

The manuscript of Part II. of the Index to the Literature of Explosives, by Charles E. Munroe, is now ready for printing, and, provided a sufficient number of subscriptions are obtained in advance to warrant doing so, it will be issued in pamphlet form, of approximately 150 octavo pages, at \$1.00 per copy.

Part I., issued in 1886, contains the Titles of all articles relating in any way to explosives that appear in: American Journal of Arts and Science, 1819-1886; Philosophical Transactions of Royal Society, 1665-1882; Journal of Royal United Service Institution, 1857-1885; Proceedings U. S. Naval Institute, 1874-1885; Revue D'Artillerie, 1871-1884; H. M. Inspectors of Explosives Reports, 1873-1885.

Part II. continues the Index for the above periodicals up to 1891 and contains the following in addition: Dingler's Polytechnisches Journal, 1820-1890; Proceedings American Chemical Society, 1879-1890; Nicholson's Journal, 1797-1813; Popular Science Monthly, 1872-1890; Edinburgh Journal of Science, 1824-1832; Brande's Journal of Science, 1816-1830.

This index has been made by a careful search of each page of each of the 984 volumes included in it, and is believed to be complete from the date of first issue of each of the periodicals named.

Professor Munroe's work is so well known as to require no other comment than the announcement of issue.

We cordially recommend the book to our readers.

Subscriptions may be sent to Professor Charles E. Munroe, Torpedo Station, Newport, R. I.

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### ARTICLES ACCEPTED FOR THE JOURNAL.

<i>Musketry Training and its Value in War,</i>	By CAPT. JAS. PARKER, 4th U. S. Cavalry,
<i>The Telegraph in War,</i>	By LIEUT. J. A. SWIFT, 9th U. S. Cavalry.
<i>Some Comments on Military Specialists,</i>	By CAPT. F. W. HESS, 3d U. S. Artillery.
<i>The Knapsack,</i>	By CAPT. WM. QUINTON, 7th U. S. Infantry.
<i>Russian View of the Pamir Question,</i>	By "ALASK."
<i>Hot-air Balloons,</i>	By CAPT. E. L. Zalinski, 5th U. S. Artillery.

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Essays have been received in competition for the Prize Medal of the Institution for 1892, from writers giving the following noms-de-plume.

Vol-reg. 36.	Noli me tangere, 76.
Semper paratus, 58.	Lexington, 3.
Reserve, 52.	Ab adaptione vis, 46.

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\*Index to the Literature of Explosives, Part II. By Charles E. Munroe, Torpedo Station, Newport, R. I.

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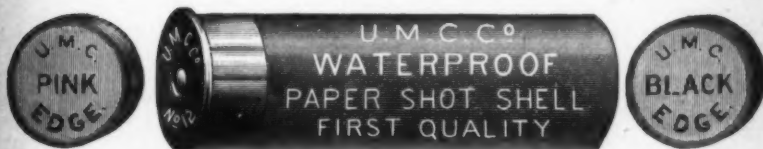
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\* Published in JOURNAL.

## THE FIFTEENTH REGIMENT OF INFANTRY.

By CAPTAIN H. R. BRINKERHOFF, 15TH U. S. INFANTRY.\*

THE first regiment of the regular establishment in the United States Army designated the "Fifteenth Infantry," was organized pursuant to an act of Congress approved by the President on the 11th day of January, 1812, and consisted of ten companies. Zebulon Montgomery Pike of New Jersey was appointed its colonel and served in that capacity until March 12, 1813, when he was appointed brigadier-general. He was killed in the assault upon the British fortifications at York [now Toronto], Canada, in the following month.

The officers of the regiment, as shown by the Army Register for 1812, consisted of one colonel, one lieutenant-colonel, one major, ten captains, ten first lieutenants, nine second lieutenants, eleven ensigns, one surgeon and two surgeon's mates. Thirty-two of these officers were appointed from New Jersey, and the others from New York, Pennsylvania and Maryland. In the following year the names of three third lieutenants appeared in addition to those of the other grades named. The regiment was disbanded in May, 1815, in conformity with an act of Congress reducing the army to 10,000 men.

It was again organized in April, 1847, under the provisions of an act of Congress approved in the preceding February, authorizing the organization of "an additional force for the war."

It served during the war with Mexico and was disbanded in 1848 after the ratification of the treaty of peace.

The beginning of the War of the Rebellion found the greater portion of the army serving upon the Indian frontier, occupying numerous small forts and cantonments, and covering a zone of country by its operations several hundred miles in width, extending from the "British Possessions" on the north, to the Gulf of Mexico on the south.

The military establishment at this time consisted of ten regiments of infantry, five regiments of mounted troops, and four regiments of artillery, aggregating about sixteen thousand officers and men. The services of these troops were greatly needed by the Government immediately after the inauguration of President Lincoln, at other points, where the exigencies of public affairs made the presence of well drilled and efficient soldiers necessary. It seemed impossible, however, to call in the garrisons of any of the frontier posts for duty elsewhere, without exposing the settlements they protected to the assaults of surrounding savages. Nor was it believed that the duties which ordinarily devolved upon these garrisons could be safely en-

\* Under the direction of Colonel R. E. A. Crofton, 15th U. S. Infantry.

trusted to new levies wholly unacquainted with the important responsibilities which would immediately confront them. The necessity for the immediate enlargement of the regular forces seemed, therefore, clearly apparent to the administration and the leading statesmen of the country with whom it conferred. With the view of determining to what extent this enlargement should properly be carried, and to decide upon the proper tactical organization for the proposed new regiments, an advisory board was instituted, consisting of the Hon. Salmon P. Chase, Secretary of the Treasury; Major Irvin McDowell, Assistant Adjutant-General; and Captain William B. Franklin, of the Engineer Corps. The board met in Washington late in April, and after a brief consultation rendered a report recommending the addition of eleven regiments to the regular establishment, and the adoption of a three-battalion organization for the regiments then in existence, as well as for those which might be added. The President approved the recommendations of the board but subsequently limited the application of the three battalion system to the new regiments.

Following promptly upon the report of the board the President, under the date of May 3, directed the organization of nine additional regiments of infantry, consisting of twenty-four companies each; one additional regiment of cavalry, and one regiment of artillery; altogether comprising an army of not less than twenty-eight thousand officers and men. The Congress was not in session at the time, but upon assembling soon thereafter hastened to confirm the order of the President by an act approved on the 29th day of July, 1861, legalizing the eleven new regiments.

The appointment of officers for the additional regiments followed the executive order as rapidly as possible, and the work of assembling and organizing the new forces was promptly begun.

General Orders No. 33, War Department, Adjutant-General's office, June 18, 1861, announces the names and lineal standing of the field officers and many of the company officers of the new regiments.

"The newly appointed officers," are admonished in the order named that they "will lose no time in making themselves thoroughly acquainted with the army regulations, the tactics of their several arms, and the various duties of their profession. None will be nominated for commissions to the Senate who have not proved themselves, meantime, to be both worthy and capable of commanding the brave men under them. That the Department may be enabled to form a proper judgment on this delicate point, all commanding officers—those of regiments and battalions more particularly—will forward to this office, in time to reach it by the 15th of July next, a statement on honor, of the moral, mental, and physical qualifications for the service, of each one of the officers belonging to their command."

The headquarters of the Fifteenth Infantry was established by this order at Wheeling, Virginia. On the 15th of July following, the removal of the headquarters to Cleveland, Ohio, was authorized by the War Department, but shortly thereafter, under further instructions it was established at Cincinnati, practically at Newport Barracks, where it remained until August, 1862, when it was transferred to Fort Adams, Rhode Island.

General Fitz John Porter, then Assistant Adjutant-General in the army

with the rank of captain, was appointed colonel of the Fifteenth Infantry, to date from the 14th day of May, 1861. His appointment to this elevated and responsible position was very favorably regarded by officers of the army in consequence of his former valuable services and his evident special fitness for the office. He was a graduate of the National Military Academy at West Point, and had served for nearly sixteen years in the line and the staff of the army. In the war with Mexico he had rendered conspicuous services, and had been breveted for distinguished gallantry in the battle of Molino del Rey, and again at the storming of Chapultepec.

Three days after the appointment of General Porter to the colonelcy of the Fifteenth Infantry he was made brigadier-general of volunteers, and immediately entered upon the duties of the latter office. He retained the colonelcy of the regiment, however, until the 21st day of January, 1863, when he was succeeded by Colonel Oliver L. Shepherd, a graduate of the Military Academy of 1840, and a veteran of the Mexican war, promoted to the office from lieutenant-colonel of the Eighteenth Infantry.

John P. Sanderson, a resident of Philadelphia, and a native of Pennsylvania, was appointed lieutenant-colonel.

Captain John H. King of the First Infantry, William H. Sidell of New York, and John R. Edie of Pennsylvania, were appointed majors to date from the 14th day of May, 1861, and were assigned to the regiment in the order named. Major King entered the service originally as a second lieutenant in the First Infantry on the 2d day of December 1837, and had been continuously in the service from that time. Sidell was a graduate of the Military Academy at West Point and entered the service originally as brevet second lieutenant in the First Artillery on the 1st of July, 1833. He left the army by resignation in October following and was a resident of New York when appointed. Edie had no previous military experience.

Fourteen captains were appointed in May, six in the following August and two in October. Among the former were First Lieutenant Peter T. Swaine, Tenth Infantry, now Colonel of the Twenty-second Infantry, and First Lieutenant Louis H. Pelouze of the Fourth Artillery. The other appointments to this grade were all from civil life. Prominent among them on account of services subsequently rendered the names of James Biddle, now Colonel of the Ninth Cavalry, Colonel Henry Keteltas of New York City, Major Thomas H. Horton, U. S. Army (retired), and Major Lynde Catlin, U. S. Army (retired), may be especially mentioned.

Nineteen first lieutenants were appointed in May and three others in August. Among the former were Second Lieutenant John T. Ritter of the Fifth Infantry, who had entered the service in July, 1856, Second Lieutenant Charles G. Harker, Second Infantry, who had entered in July, 1858, and James Curtis, who had served from July 1, 1851, to January 15, 1857, in the Second Infantry. These gentlemen were all graduates of the Military Academy at West Point. The other appointments were from civil life. Among the latter were Horace Jewett of Maine, now Colonel of the Twenty-first Infantry, George M. Brayton, Lieutenant-colonel of the Ninth Infantry, George H. Tracy, Major U. S. Army (retired), and Charles A. Wikoff, Lieutenant-colonel Nineteenth Infantry.

But two second lieutenants were assigned to the regiment during the year.

Nearly all the officers assigned to the Fifteenth Infantry in 1861 were set at work recruiting for the regiment immediately upon reporting for duty, and were sent for this purpose to Cincinnati and other cities, and to the towns and villages within a radius of one hundred and fifty miles or more about Newport. Recruiting stations were established at these places and every possible means taken to hasten enlistments.

Notwithstanding these efforts recruits were not obtained as rapidly as had been expected, and the companies filled up slowly. Previous to the war many influential persons, both in the army and out of it, had advocated the maintenance of skeleton company or regimental organizations, with the view of their enlargement in case of necessity. This theory found but little support in the experience of the new regular regiments. Volunteer regiments were frequently raised in a day, but it took months to fill up the ranks of the regular regiments. Men hastened in bodies to join the volunteer forces, but they came individually to join the regulars.

The reasons were obvious.

Social relations and the prospect for early preferment popularized the volunteer service, and thus enabled it to absorb the greater portion of available recruits.

Early in September, 1861, General Buckner, in command of a large Confederate force, entered Kentucky from the south, and later in the month pushed his way up through Bowling Green towards Louisville and threatened the capture of that place. General Robert Anderson, of Fort Sumter fame, was in command at Louisville at the time and with a meagre force under his orders found it necessary to call upon Colonel Sanderson for assistance. On the 20th of September two companies were organized from the recruits then in camp at Newport Barracks and sent by rail to Louisville on the same day. These companies were designated A and B, First Battalion, and were the nucleus of the regiment in the field. They remained in active service from this time until the close of the war.

On the day following their arrival at Louisville they marched to Nolin, Kentucky, where they remained until October 10th, when they proceeded to Bacon Creek, on the Louisville and Nashville Railroad. In November they were joined by Major John H. King with Companies C, D, E and F, and the battalion as thus constituted marched to Mumfordsville shortly thereafter, where it was joined by Companies G and H in January, 1862.

Early in February Major King was directed to proceed with his battalion to join the forces under General Grant, then operating against Fort Donelson. The battalion reached Bacon Creek after a few hours marching, *en route for Tennessee*, where it learned of the fall of Donelson on the 16th, and found orders to proceed to Bowling Green. On reaching the latter place Major King was directed to continue his march and join the forces operating against Nashville, Tennessee. The battalion reached Nashville a few days after the occupation of the city and its defenses by the Federal forces, and was assigned to the Fourth Brigade (Rousseau), Second Division (McCook), Army of the Ohio. Brig.-General Lovell H. Rousseau, in

command of the brigade, was a veteran of the Mexican War and one of the most efficient and popular officers then in the service. The Fourth Brigade, as now constituted, consisted of the First Ohio; Fifth Kentucky (Louisville Legion); Sixth Indiana; First Battalion, Fifteenth Infantry; First Battalion, Sixteenth Infantry; First Battalion, Nineteenth Infantry, and Battery H, Fifth Artillery.

In the meantime the Army of the Tennessee had moved up the Tennessee River as far as Pittsburg Landing, with the view of operating against the Confederate army under Johnston at Corinth.

Late in March the division was put in motion to join the forces under General Grant at Pittsburg Landing, and after several days hard marching reached Savannah on the Tennessee River, about nine miles below Pittsburg, late in the evening of the 6th day of April. The men were hastily embarked on boats which were found at the landing, and the vanguard of the division, consisting of Rousseau's Brigade, reached Pittsburg Landing about five o'clock on the following morning.

"Out of justice to General McCook and his command," says General Grant in his Memoirs, "I must say that they left a point twenty-two miles east of Savannah on the morning of the 6th. From the heavy rains of a few days previous and the passage of trains and artillery, the roads were necessarily deep in mud, which made marching slow. The division had not only marched through this mud the day before, but it had been in the rain all night without rest. It was engaged in the battle of the second day and did as good service as its position allowed. In fact an opportunity occurred for it to perform a conspicuous act of gallantry which elicited commendation from division commanders in the Army of the Tennessee."

A little after six o'clock McCook marched to the front with Rousseau's Brigade and formed on Crittenden's right facing towards Shiloh Church, and about seven o'clock engaged the enemy in his front consisting of portions of Polk's and Breckinridge's Corps.

"When Rousseau's Brigade was formed," says General M. F. Force, in his extended narrative of the battle, "his right was in the air. McCook, however, held it in place till Kirk's Brigade arrived, when Rousseau moved forward across a ravine to a rising ground a few hundred yards in advance. A company of regulars was sent into the woods in its front as skirmishers. In less than an hour the skirmishers were driven back, followed by the Fourth Kentucky Regiment and the Fourth Alabama Battalion, belonging to Trabue's Brigade. After a fierce attack for twenty minutes the assailants fell back before the rapid and well-directed fire of Rousseau's men, and retired out of sight in the timber. Trabue's regiments rallied and quickly returned to the assault with greater vigor than before. The steady fire of Rousseau's men again drove them to retreat. Rousseau then advanced into the timber and passed through it to an open field, when Trabue once more charged furiously upon Rousseau with his entire brigade. After a desperate struggle Trabue gave way leaving two guns in Rousseau's possession. The conflict now raged about Shiloh Church with a fury surpassing any portion of the battle on the preceding day. Generals McClernard, Sherman and Wallace all speak with admiration of the splendid fighting of McCook's Divi-

ion. Wood's rebel brigade finally charged on Rousseau and was knocked to pieces and retired to the rear. McCook now pushed his lines forward and the fire became hotter than ever. General Grant called two regiments and in person led them in charge in McCook's front and broke the enemy's line."

General Grant made no official report of the battle of Shiloh, but in his *Memoirs* he gives an extended account of his own movements and those of the troops which participated in the battle under him. In this narrative he makes no mention of having "led two regiments" on the eventful second day of the engagement. He speaks, however, of a "conspicuous act of gallantry" performed by the troops under General McCook. This "conspicuous act of gallantry," was the charge of Rousseau's Brigade, led by the Fifteenth and Sixteenth Infantry, against the Confederate line after the repulse of Wood's command. The whole of Rousseau's Brigade doubtless joined in the movement, for General Rousseau in his official report of the battle says that he observed two regiments advancing at "double quick time." One of these regiments he says, "was the First Ohio, which had been moved to our left to wait for ammunition. I galloped to the regiment and ordered it to halt, as I had not ordered the movement, but was informed that it was advancing by order of General Grant, whom I then saw in rear of the line with his staff. I ordered the regiment to advance with the others which it did. \* \* \* This closed the fighting of the day."

The movement had evidently gotten well under way before General Rousseau knew anything about it, and the two regiments he observed moving forward at "double quick time," were doubtless the last of his brigade to join in the advance.

"Shortly after the defeat of Wood's Brigade," says an officer who participated in the battle, in command of a company of the Sixteenth Infantry, "an officer rapidly approached the battalions of the Fifteenth and Sixteenth Infantry from the rear and cried, 'Charge! Charge! by order of General Grant!'"

The Fifteenth and Sixteenth moved forward instantly to the front and swept everything before them in the grand charge which General Forcesays "broke the enemy's line."

The hitherto obscure spot known in the Federal reports as Pittsburg Landing and in the Confederate reports as Shiloh, is now historic as the scene of the second great battle in the War of the Rebellion. Few battles anywhere were more destructive in proportion to the number engaged, about one man in five having been killed or wounded in the battle.

In the Fifteenth Infantry four men were killed and four officers,—Captains Keteltas, Peterson, Curtis and Wikoff—and fifty-five men were wounded.

After the battle of Shiloh the Confederate army retired to Corinth where it intrenched itself and awaited the further advance of the Federal troops. General Halleck having assumed command of the combined forces of the Army of the Tennessee, the Army of the Ohio and the Army of Mississippi, began his march towards Corinth about the close of April. After several successive advances, meeting more or less opposition, the armies finally reached the main intrenchments before Corinth on the 27th day of May.

"The movement was a siege from the start to the close," says General Grant, "The National armies were thoroughly intrenched all the way from the Tennessee River to Corinth."

General Beauregard evacuated the place on the 30th of May and retreated southward.

The battalion had now been through a somewhat hard and certainly a very practical schooling. In addition to its experience under fire at the battle of Shiloh, it had been given daily practical lessons in picket duty, the construction of field fortifications and the building of roads and bridges during the slow advance upon Corinth. It had learned something of the grim business of war and was now well prepared for further campaign or battle, or siege, as might be required.

In June the battalion proceeded to Huntsville, Alabama, by the way of Iuka, Tuscumbia, Florence and Athens. The weather was extremely warm and the roads over which the battalion marched were dry and dusty. The Subsistence Department was unable to furnish full rations at any time during the march and frequently the supply was scant.

On the 1st day of June the Second Battalion left Newport Barracks and proceeded to Columbus, Kentucky, where it went into camp on the 6th of the month. It remained at Columbus until February, 1863, when it was ordered to Memphis. It remained at this place until October of the same year when it joined the First Battalion at Chattanooga.

During July and August the First Battalion was almost constantly on the march, enlivened at times by skirmishes with the enemy and the usual incidents and discomforts of active field service. On the 24th day of August it broke up its temporary camp at Cowan Station, Tennessee, on the Nashville, Chattanooga and St. Louis Railroad, and leaving behind its camp equipage, marched through Pelham and Altamonte, down the Cumberland Mountains to Hubbard's Cave, on through Murfreesborough, Nashville and Bowling Green, reaching Louisville, Kentucky, on the 26th of September, 1862, having marched almost continuously about four hundred miles, "without our camp equipage," says Major King, "the whole time without the ordinary allowance of rations, and some days totally without any."

After four days rest at Louisville the First Battalion started on another extended march which took it through Shelbyville and Laurenceburg, Kentucky, to Chaplin Hills, where a portion of General Kirby Smith's Confederate command was encountered on the 9th of October, resulting in the loss of one man killed and two wounded in the battalion. General J. W. Sill, in command of the forces of the expedition, reports the affair as a "smart skirmish," resulting in the loss of five men killed and thirty-three wounded and missing in the command.

From Chaplin Hills the battalion marched on with General Sill's command through Perrysville and Danville to Crab Orchard, and then back to Bowling Green, where it arrived on the last day of October, having made an almost continuous march of three hundred miles, "without its camp equipage," says Major King, "and part of the time suffering for want of rations."

On the 8th of November the battalion continued its march and pro-

ceeded directly to Nashville, where it remained until the 26th of December. On that date it moved on towards Murfreesborough, Tennessee, as a part of the "Regular Brigade." This brigade, subsequently famous in the annals of the Army of the Cumberland, was organized a few days before the movement upon Murfreesborough began, and consisted entirely of regular troops, as follows: First Battalion Fifteenth Infantry, under Major King; First Battalion and one company of the Second Battalion, Sixteenth Infantry; First and Second Battalions, and six companies of the Third Battalion, Eighteenth Infantry; First Battalion Nineteenth Infantry, and Battery H, Fifth Artillery. Lieutenant-Colonel Oliver L. Shepherd, Eighteenth Infantry, subsequently Colonel of the Fifteenth Infantry, commanded the brigade.

About eleven o'clock on the 30th day of December, Rousseau's Division, to which the Regular Brigade belonged, reached its position in the Federal line before Murfreesborough, and bivouacked near the Nashville turnpike on the night preceding the sanguinary battle of Stone's River.

"At about nine o'clock A. M. on the 31st of December," says General Rousseau, in his official report of the battle, under date of January 11th, 1863, "the report of artillery and heavy firing of small arms on our right announced that the battle had begun by an attack on the right wing, commanded by Maj.-General McCook. \* \* \* General Thomas ordered me to advance my division quickly to the front to the assistance of General McCook. \* \* \* We consulted and agreed as to where the line should be formed. This was in a dense cedar brake, through which my troops marched in double-quick time, to get into position before the enemy reached us. He was then but a few hundred yards to the front sweeping up in immense numbers, driving everything before him. \* \* \* The roads were almost impassable to infantry, and artillery was perfectly useless. \* \* \* Our lines were hardly formed before a dropping fire of the enemy announced his approach. \* \* \* Four deliberate and fiercely sustained assaults were made upon our position and repulsed." After the last assault "we made a charge upon the enemy and drove him into the woods. \* \* \* This ended the fighting of that day. \* \* \* From the evening of the 31st until the ensuing Saturday night (January 3d), no general battle occurred in front of my division. \* \* \* During much of the time my men had neither shelter, food nor fire. I procured corn, which they parched and ate, and some of them ate horse steaks, cut and broiled, from horses upon the battle-field. \* \* \* The troops of my division behaved admirably. I could not wish them to behave more gallantly. \* \* \* The Brigade of United States Infantry, Lieut.-Col. O. L. Shepherd commanding, was on the extreme right. On that body of brave men the shock of battle fell heaviest, and its loss was most severe. Over one-third of the command fell, killed or wounded; but it stood up to the work and bravely breasted the storm, and though Major King, commanding the Fifteenth, and Major Slemmer ("Old Pickens"), commanding the Sixteenth, fell severely wounded, and Major Carpenter, commanding the Nineteenth, fell dead in the last charge, together with many other brave officers and men, the brigade did not falter for a moment. \* \* \* If I could, I would promote

every officer and several non-commissioned officers and privates of this brigade of regulars, for gallantry and good service in this terrific battle. I make no distinction between these troops and my brave volunteer regiments, for in my judgment there never were better troops than those regiments, in the world. But the troops of the line are soldiers by profession and with a view to the future I feel it my duty to say what I have of them."

The loss of the battalion of the Fifteenth Infantry, in killed and wounded was severe. It went into the engagement with sixteen officers and three hundred and four enlisted men. One officer—Captain Bell—was killed, and three officers—Major King, Captain Yorke and Lieutenant Oceleston—were severely wounded. Ten men were killed and ninety-one men wounded and missing.

The command of the Fifteenth devolved upon Captain Fulmer after Major King was wounded. Captain Crofton, now Colonel of the Fifteenth, succeeded to the command of the Sixteenth after Slemmer was disabled, and Captain Mulligan to the command of the Nineteenth after the death of Carpenter.

General Rosecrans in his official report of the battle under date of February 12, 1862, makes "special mention" of Captain Fulmer, Fifteenth Infantry, Captain Crofton, Sixteenth Infantry and Captain Mulligan, Nineteenth Infantry.

"These three infantry captains," he says, "commanded their respective battalions after their majors had been disabled, and behaved with great gallantry and skill, although opposed by an overwhelming number."

The battle reopened on the morning of January 1st and was continued throughout the day and the two following, when the Confederate army retired southward.

On the evening of the second day of the battle, the wagon transportation of the Regular Brigade was directed to proceed to Nashville. It got away early on the following day under charge of Lieutenant Clarence M. Bailey, Sixth Infantry, now Major of the Fifteenth Infantry. The regimental band of the Fifteenth reported to Lieutenant Bailey and accompanied the transportation under orders *en route* for Nashville. A sufficient number of the wagons were furnished to the band to carry the men as well as their instruments and personal effects. The roads were rough and the jolting of the wagons often made riding in them less desirable than walking. As a result the men scattered along the way and the wagons assigned for their use were often delayed, waiting for those who had fallen behind to come up. Finally when the band with its transportation reached La Vergne, about sixteen miles from Nashville, it was suddenly surrounded by a detachment of Wheeler's cavalry and the whole concern from trombone to piccolo captured bodily.

Lieutenant Bailey had gone on ahead a short time before and fortunately escaped capture. When the officer in command of the Confederate troops became aware of the character of his capture he at once set the men at liberty after exacting the usual parole. The transportation, however, and the instruments of the band, together with the personal effects of the men, were appropriated by the captors and carried away. The Confederate

officer kindly addressed Major King by letter, entrusting his communication for delivery by a member of the band, announcing that he had paroled the men, and offering to return the instruments if their value in money was sent to his command under flag of truce. The result is not known, but it is believed that the instruments were never recovered.

The band bore an excellent reputation in 1862-63, and its friends claimed first place for it in the Army of the Cumberland. It was recruited from the members of the orchestra of Pike's Opera House in Cincinnati, and many of the performers were excellent musicians.

On the 5th of January, 1863, the battalion moved into Murfreesborough and established a camp which it occupied until the latter part of June. It joined then in the forward movement of the Army of the Cumberland and marched to Hoover's Gap and on through Fairfield to Manchester, Tennessee. After a brief delay at Manchester, it moved on towards Stevenson, Alabama, which place it reached on the 10th day of August. It left Stevenson on the 9th of September and marched through Bridgeport, Tennessee, crossed the Tennessee River and the Raccoon and Lookout Mountains, and finally on the 19th day of the month reached the historic battle-field of the Chickamauga.

The battalion at this time formed a part of the "Regular Brigade," now commanded by Brigadier-General John H. King, formerly major of the Fifteenth Infantry. The brigade consisted of the First Battalion, Fifteenth Infantry—six companies only being present with it at this time, B and D having been left behind on some detached duty—and Company E, Second Battalion, under command of Captain A. B. Dod; First Battalion, Sixteenth Infantry; First and Second Battalions, Eighteenth Infantry; First Battalion, Nineteenth Infantry; and Battery H, Fifth Artillery.

At the opening of the battle on the morning of the 19th Captain Dod was directed to take position in the rear of the battery belonging to the brigade and follow its movements.

"In accordance with these instructions," says the captain in his official report, "I was following close on the battery, moving to the front in line of battle, when I was informed that the skirmishers of the enemy were about eight rods on our right \* \* \*."

"Upon reaching a dense thicket," says Captain Heilman of the Fifteenth, "a division staff officer cautioned us not to fire in a certain direction as there was a body of our troops in advance of us. He had scarcely gotten out of sight when a volley was poured into us, and we found that instead of our own troops we had Longstreet's Corps in our front. Our line wavered, as it naturally would under such circumstances, but soon recovered itself. In the meantime, however, one section of our battery had been captured. The battalion was immediately ordered forward again, and closing upon the enemy's lines recaptured the section and with it a large number of prisoners. It was all done so bravely and quickly that the guns were recovered uninjured. The volley that we received was a solid one, but the firing was so high that the loss of men was small. As soon as possible we gathered our prisoners together and sent them to the rear."

Continuing his report of the operations of the 20th, Captain Dod says,

"I was then ordered to relieve the Eighteenth in the outer breastworks, which were only a few logs raised about a foot and a half above the ground. \* \* \* The enemy made four efforts to take the works, but were each time repulsed with terrible slaughter, the ground in front being literally strewn with their dead and wounded."

"We resisted the assaults successfully behind our little stronghold," says Captain Heilman, "until our ammunition became exhausted, when we were driven back. The enemy were apparently determined to dislodge us and they persisted until they succeeded. In falling back we discovered that we had been almost surrounded. My company was in the centre and we hardly knew what direction to take. At length we got under cover of the woods when it was found that all the officers to my right and a large number of men had been captured. As we fell back we were heavily fired into and the ground was covered with the dead and wounded of both armies. We were crowded very closely and fell far back, being entirely out of ammunition. Darkness soon came on and closed the eventful day. On the following day we crossed Missionary Ridge and early on the 22d reached Chattanooga with Bragg's army pretty close on our heels and the Tennessee River in front of us."

The battalion went into the engagement on the 19th with fourteen officers and two hundred and sixty-two men. Its casualties included nine men killed, two officers,—Captain Meredith and Lieutenant Williams—and forty-seven men wounded, and six officers—Lieutenants Timony, Gray, Holbrook, Galloway, Kendall and Brown,—and eighty-eight men captured by the enemy.

The battalion immediately went to work after its camping ground had been determined upon to make itself as comfortable as possible with such material as could be obtained.

"Our camp," says Heilman, "soon presented a unique and rather picturesque appearance. The quarters were constructed of anything we could get in the way of canvas and sticks, and our 'dog houses,' as the structures we erected were commonly called, were a sight to behold."

In the meantime large details of officers and men were daily employed in the erection of fortifications and the building of bridges and roads, while other large details were constantly employed in watching the enemy.

For nearly two months every man in the command was kept busy night and day, either watching the enemy or adding to the means of defense against him. During all this time the supply of food and clothing was barely sufficient to meet the daily wants of the troops and much suffering resulted.

About the middle of October, 1863, General Grant was placed in command of a geographical division embracing the Departments of the Ohio, the Cumberland and the Tennessee, and General Thomas succeeded General Rosecrans in command of the Army of the Cumberland. General Grant reached Chattanooga on the 24th and operations were at once begun to relieve the siege which the Confederates under General Bragg had maintained since the unfortunate battle of Chickamauga.

"The national troops were now strongly entrenched in Chattanooga

Valley," says General Grant in his Memoirs, "the Tennessee River behind them and the enemy occupying commanding heights to the east and west, with a strong line across the valley from mountain to mountain. \* \* \* All supplies for Rosecrans had to be brought from Nashville \* \* \* and hauled by a circuitous route north of the river over a mountainous country \* \* \* This country afforded but little food for his animals, nearly ten thousand of which had already starved, and not enough were left to draw a single piece of artillery, or even the ambulances to convey the sick. The men had been on half rations of hard bread for a considerable time, with but few other supplies except beef driven from Nashville across the country. The region along the road became so exhausted of food for the cattle that by the time they reached Chattanooga they were much in the condition of skeletons. Indeed the beef was so poor that the soldiers were in the habit of saying with a faint facetiousness, that they were living on half rations of hard bread and *dried beef on the hoof*."

The Second Battalion of the Fifteenth Infantry, under command of Major Edie, reached Chattanooga on the 2d day of October, 1863, and went into camp with the First Battalion. The road it had followed on the previous day was found so difficult for the wagon train by reason of mud and broken ground that the battalion became separated from it while *en route*. Some time after the separation occurred the train was captured by a force of the enemy's cavalry and was entirely destroyed, together with all the public records of the battalion, its camp equipage, and the private property of the officers and men. Lieutenant Lord and nineteen men, escorting the train, were made prisoners of war.

Major Albert Tracy, promoted from captain Tenth Infantry, joined on the last day of December, 1863, and assumed command of the First Battalion. He entered the service originally as first lieutenant of the Ninth Infantry, in 1847, and had rendered continuous service since that date.

"It was a rough winter we spent at Chattanooga," he says. "I had served in the expedition to Utah in 1857-58 and participated in the hardships, privations and starvations of that luckless march, but taking all I saw or felt in the expedition to Utah into consideration I must say that I never beheld so much suffering and misery from want of food and clothing as I saw in the camps of the Federal troops at Chattanooga from the date of my joining until the opening of February, 1864."

"I telegraphed Thomas from Washington," says General Grant, "that he must hold Chattanooga at all hazards. A prompt reply was received saying, 'We will hold the town till we starve.' I appreciated the force of this despatch later when I witnessed the condition of affairs which prompted it. It looked, indeed, as if but two courses were open; one to starve, the other to surrender or be captured."

"For tents," continues Major Tracy, "a few blackened specimens were left, but there were not wanting instances where soldiers were compelled for want of covering to burrow in the side of the hills like animals to escape the piercing inclemencies of the weather. It was only when we opened the newspapers, which now and then reached us from the North, that we felt

assured that the men at Chattanooga were amply fed and clothed and eager for battle."

On the 25th of November, 1863, the First Battalion under Captain Keteltas, and the Second under Major Edie, broke camp at Chattanooga and participated with the other regiments of the Regular Brigade in the assault upon Missionary Ridge, losing four men killed and eleven wounded. Both battalions participated in the pursuit of the enemy as far as Ringold, Georgia, but without further casualties. The First Battalion returned to its camp at Chattanooga on the 29th, followed by the Second Battalion on the same day.

No further movements of the regiment occurred until the 22d of February, 1864, when the First Battalion marched to Ringold and on the following day to Tunnel Hill. On the 26th it participated in a skirmish with a considerable force of the enemy at Buzzards' Roost, and during the following night retreated to Stone Church. Continuing the march on the 27th it reached Tyner's Station, Tennessee, on the same day and bivouacked near that place until the 2d day of March when it marched to Graysville, where it was joined by the Second Battalion on the 12th, and a few days later by Companies A and B of the Third Battalion under Captains Dod and Jewett. On the 20th of April the First Battalion advanced as far as Parker's Gap to make an armed reconnoissance of the enemy's position and returned to Graysville on the 25th.

Both battalions and Companies A and B, Third Battalion, broke up their encampment on the 3d of May and joined in the forward movement of the Army of the Cumberland, forming part of the Second Brigade (General King); First Division (General Johnson); Fourteenth Corps (General Palmer). The brigade consisted of the Nineteenth Illinois; Eleventh Michigan; Sixty-ninth Ohio; First and Second Battalions and Companies A and B Third Battalion, Fifteenth Infantry; First and Second Battalions Sixteenth Infantry; First and Second Battalions Eighteenth Infantry, and First Battalion Nineteenth Infantry.

Early in the month Major Tracy relinquished command of the First Battalion owing to illness, and was succeeded by Captain Dod. After the battle of Kenesaw Mountain, Dod resigned and the command of the battalion then devolved upon Captain Curtis. At the beginning of the battle of August 7th, before Atlanta, Curtis was wounded and the command of the First Battalion in this and subsequent battles was then exercised by Captain Jewett. The companies of the Third Battalion served with the First.

Both battalions took part in the actions with the enemy during the month of May at Buzzard's Roost, Resaca, and New Hope Church. The casualties of the regiment in these engagements aggregated one officer—Lieutenant Forbes—and ten men killed, and twenty-seven men wounded. Following the retrograde movements of the enemy the regiment participated almost constantly in skirmishing with the rear guard of the Confederate army, and during the latter part of the month of June, in preparing approaches to the enemy's position on Kenesaw Mountain.

The losses of the regiment in these skirmishes during June aggregated one officer—Captain Harker—and five men killed, and fourteen men

wounded. At the time of his death Captain Harker was in command of the Third Brigade, Second Division, Fourth Army Corps, with the rank of colonel of volunteers.

Companies C and D, Second Battalion, reached the command about the last of the month and were attached to the First Battalion.

On the 3d of July the regiment joined in the pursuit of the enemy, participating in skirmishes with the Confederate rear guard at Marietta and Neil Dow Station, finally taking position in front of Atlanta on the 20th. The losses sustained by the regiment during the month aggregated five men killed and one officer—Lieutenant Jackson—and twenty-five men wounded.

The regiment participated in the siege of Atlanta, and on the 7th day of August joined with a part of the brigade to which it belonged in assaulting the enemy's entrenched position, meeting with partial success, a number of prisoners being taken and the line of brigade advanced. On the 28th and 29th the regiment was employed in destroying the "Montgomery and Atlanta" and the "Atlanta and West Point" railroads. The casualties of the regiment during the month aggregated eighteen men killed, and one officer—Captain Curtis—and one hundred and three men wounded.

On the 1st day of September the regiment marched to Jonesborough and joined in a charge upon the enemy's works at that place on the afternoon of the same day. On the 7th it returned to its former position in front of Atlanta and late in the day entered the city, then in possession of the Federal troops, and bivouacked at White Hall in the suburbs.

The campaign up to this time had been extremely laborious, and the regiment, in common with all other troops in the Army of the Cumberland and the Army of the Tennessee, had suffered severely from numerous privations and the incessant labor attending the ceaseless operations of the Federal forces. During a considerable portion of the time rain fell with unusual frequency and its dispiriting effects upon both men and animals was often quite noticeable. The wagon-roads over which supplies were obtained soon became almost impassable, and sufficient food for the army was with difficulty procured.

"It would only weary the reader's patience," says General Howard in an article published in the *Century Magazine*, "to follow up the struggle step by step from New Hope Church to the Chattahoochee. Still these were the hardest times which the army experienced. It rained continuously for seventeen days; the roads becoming as broad as the fields, were a series of quagmires, and indeed it was difficult to bring enough supplies forward from Kingston to meet the needs of the army."

Scarcely a day elapsed after the regiment left Graysville until the Confederate army abandoned Atlanta without some casualty occurring in its ranks, resulting from the advance of the skirmish line or from contact with the enemy in battle. Outpost duty was particularly severe and constantly embraced a large portion of the command. Hasty entrenchments were invariably prepared whenever the regiment halted, and the men always slept on their arms.

"No regiment was long in front of Johnston's army," continues General Howard, "without having virtually as good a breastwork as an engineer

could plan. A ditch was sunk before the embankment and a strong log revetment established behind it, and a heavy 'top log' put in place to shelter the heads of the men. I have known a regiment to shelter itself completely against musketry and artillery with axes and shovels in less than an hour after it reached its position."

On the 28th day of September, 1864, the regiment was directed to return to Chattanooga, where it arrived by rail on the 29th. On the following day it established its camp near the summit of Lookout Mountain, where it remained until the close of the war.

The losses of the regiment during September, were seven men killed and twenty wounded.

During its entire field service the losses of the Fifteenth Infantry—largely confined to the First Battalion—aggregated three officers killed, fourteen wounded and five captured; seventy-six men killed, three hundred and seventy-five wounded, and one hundred and forty-five captured.

It participated with one or two battalions in nine great battles, as follows, and in several minor affairs and skirmishes in which casualties occurred:

Shiloh, First Battalion, April 7, 1862.

Stone's River, First Battalion, December 31, 1862.

Chickamauga, First and Second Battalions, September 19, 20 and 21, 1862.

Missionary Ridge, First and Second Battalions, November 25, 1863.

New Hope Church, First and Second Battalions and Companies A and B Third Battalion, May 2, and June 5, 1864.

Kenesaw Mountain, First and Second Battalions, and Companies A and B, Third Battalion, June 23 to 30, 1864.

Neil Dow Station, First and Second Battalions, and Companies A, B, C and D, Third Battalion, July 3 and 4, 1864.

Utoy Creek, First and Second Battalions, and Companies A, B, C and D, Third Battalion, August 7, 1864.

Jonesborough, First and Second Battalions, and Companies A, B, C and D, Third Battalion, September 1, 1864.

In August, 1865, the Regular Brigade was broken up and the regiments composing it were sent to various parts of the country. The First Battalion Fifteenth Infantry was sent to Fort Adams, Rhode Island, in whole or in part, and the Second and Third Battalions to Mobile, Alabama. In December two companies of the First Battalion were sent from Fort Adams to Mobile, and in January and February, 1866, the other companies of the battalion followed. The Second Battalion, under Major Dudley, went to Vicksburg in January, and in March the regimental headquarters was transferred from Fort Adams to Mobile, arriving at the latter place on the last day of the month.

The experience of the regiment while at Mobile was quite uneventful. It was called upon for a while after its arrival to perform the duties of watchmen and policemen in the city, but this ceased as soon as a local government was organized. After this was fully accomplished its duties were quite strictly confined to drills and guards and the other monotonous routine labors of camp life in time of peace.

On the 28th of July, 1866, the President approved an act of Congress fixing the permanent establishment at forty-five regiments of infantry of ten companies each. In carrying out the provisions of this act General Orders 92, Adjutant-General's office, issued on the 23d day of November, 1866, announced the First Battalion as the Fifteenth Infantry; the Second Battalion as the Twenty-fourth, and the Third Battalion as the Thirty-third.

The field officers and the captains of the reorganized regiment as announced in this order were, Colonel Oliver L. Shepherd, Lieutenant-Colonel Julius Hayden, Major E. McKay Hudson, and Captains Keteltas, Yorke, Curtis, Jewett, Tracy, Fetterman, Potter and Semple. Captains Cummings and Gillette were subsequently assigned to the regiment. Lieutenant Coleman was made Adjutant, and Lieutenant Buffum Quartermaster.

In July, 1866, the headquarters of the regiment was removed to Macon, Georgia, where it remained until September, when it was again established at Mobile. Owing to the prevalence of yellow fever in the latter city in the fall of 1867 the headquarters and five companies of the regiment then constituting the garrison of Mobile, went into camp at Stark's Landing on the "eastern shore" of Mobile Bay about the middle of September. In December the headquarters and the companies serving with it broke up the camp at Stark's Landing and returned to the city.

Early in February, 1868, the headquarters of the regiment was removed to Montgomery, Alabama, and General Shepherd was placed in charge of the Sub-District of Alabama. Lieutenant Hartz was assigned to duty as Adjutant-General of the District. At this time Heilman's company (A), Shorkley's (B) and Coleman's (I) were stationed at Huntsville, Alabama; Potter's (C), and Jewett's (D) at Montgomery, Hedberg's (E), at Jacksonville, and Curtis' (H), Stewart's (F), Brown's (G) and Gillette's (K), at Mobile. Some changes afterwards occurred in the stations of the companies, but it is not possible to follow these movements in this abbreviated history of the regiment.

Early in August, 1868, the regiment concentrated in Mobile, and on the 16th of the month proceeded on board the iron steamship *Morgan* for New Orleans, *en route* for Texas. On reaching New Orleans the regiment was divided into detachments and continued its journey in three river boats up the Mississippi to the mouth of the Red River, and then up that stream to Shreveport, from which place it was transported by rail to Marshall, Texas. Here a distribution of the companies was made for "reconstruction duty" in the eastern portion of the State. Regimental headquarters and Potter's company (C), and Jewett's, (D), were sent to Nacogdoches; Heilman's, (A), to Livingston; Hedberg's, (E), to Palestine; Stewart's, (F), to Huntsville; Curtis', (H), to Jefferson and Shorkley's, (B), Brown's (G), Coleman's, (I), and Gillette's, (K) remained at Marshall.

Early in the spring of 1869 the question of the reduction of the army came before Congress, and for some time was a prominent subject of consideration. A clause was finally attached to the army appropriation bill, reducing the number of infantry regiments to twenty-five. The bill as thus amended passed the House and subsequently the Senate, and on the 3d day of March received the approval of the President. In carrying out the provisions of the law an order was issued from the Adjutant-General's office, on

the 11th day of March, directing the consolidation of infantry regiments, including the Fifteenth and Thirty-fifth.

The Fifteenth assembled at Austin, Texas, in the following June, and after a somewhat prolonged delay, due principally to frequent heavy rains and the consequent swollen condition of the Colorado River, got away finally on the 16th day of July, *en route* for Fort Concho, Texas, at which point the reorganization of the regiment was to be effected by consolidation with the Thirty-fifth.

The regiment reached Concho early on the following month and went into camp on the Concho River, not far from the Fort, and immediately adjoining the camp of the Thirty-fifth, which had preceded it by a few days. On the 12th day of August, the final order carrying into effect the consolidation of the two regiments, was published and on the 18th formally executed.

The field and staff officers and the captains of the regiment as now constituted were: Colonel Oliver L. Shepherd, Lieutenant-Colonel August V. Kautz, Major John S. Mason, Captains Ellis, Jewett, Whittemore, McKibben, Hedberg, Steelhammer, Shorkley, Brown, Coleman and Stewart. Lieutenant Sartle was continued as adjutant and Lieutenant Blair as quartermaster.

On the 19th day of August the regiment marched from Concho on its way to New Mexico, following the old "Butterfield Trail" across the Great Staked Plain. Two large tanks filled with water from the Concho River were taken with the command, and a limited amount of water for drinking purposes was served from them to the companies at intervals when needed. The regiment reached the Pecos River at "Horse Head Crossing" on the evening of August 25th and on the following day crossed the river in small detachments by means of a raft improvised by lashing together the water tanks, now empty. The impedimenta were taken from the wagons and crossed by the same means.

On the 13th day of September the command reached the Rio Grande River about three miles below Fort Quitman, and continuing its march up the river arrived at Fort Selden, New Mexico, on the 27th day of the same month. At this point the distribution of the companies of the regiment for their posts in the District of New Mexico began.

The last day of the month found the regiment again on the road. The headquarters and five companies continued on up the river and the other companies separated for their several posts. Hedberg's company for Fort Cummings; Jewett's for Fort Bascom; McKibben's for Fort Stanton and Whittemore's and Steelhammer's for Fort Bayard.

On reaching Fort Craig, the regimental headquarters and Shortley's and Coleman's companies took station at that place. The remaining companies continued on for their stations which they reached about the middle of October; Brown's and Stewart's companies to Fort Wingate and Ellis' to Fort Garland, Colorado.

The journey from Austin to Concho, across the Great Staked Plain, and up the Rio Grande, was admirably well conducted. With the exception of two or three long marches that involved much fatigue and discomfort, no severe physical exertions were imposed upon the troops, or privations endured unusual to ordinary marches of brief duration in effecting changes

of station. The average distance marched by the companies from their stations in Texas to their new stations in New Mexico approximated fifteen hundred miles.

On the 15th of December, 1870, Colonel Shepherd was retired at his own request under the provisions of the act of July 15 of that year, and was succeeded on the same day by Colonel John E. Smith, who in turn was followed by Colonel Gordon Granger on the 20th of July, 1870. After about five years service with the regiment, Colonel Granger died at Santa Fé, New Mexico, and was succeeded by Colonel George A. Woodward, on the 10th day of January, 1876. Colonel Woodward never joined and was finally retired on the 20th of March, 1879. Colonel George P. Buell followed and after a brief service with the regiment went to Tennessee on sick leave, where he died in May, 1883. He was succeeded by Colonel J. N. G. Whistler, who was retired in 1886.

Colonel R. E. A. Crofton, at present in command of the regiment, was promoted colonel on the 19th day of October, 1886, and has served continuously with the regiment since November 20th of that year. He entered the service as Captain of the 16th Infantry in 1861, was promoted Major 14th Infantry in 1868, and Lieutenant-Colonel 13th Infantry in 1879.

He was promoted major by brevet, for gallantry in the battle of Shiloh, and in the following year further distinguished by the brevet of lieutenant-colonel for gallant conduct at Chickamauga and Missionary Ridge.

He commanded the First Battalion of the Sixteenth Infantry after Major Slemmer was wounded early on the first day of the battle of Stone's River, and was subsequently recommended by General Rosecrans in his official report of the battle for further promotion by brevet, in consideration of gallant services rendered in that engagement.

He also commanded the First Battalion of his regiment at Chickamauga and Missionary Ridge.

The regiment remained in New Mexico a little over twelve years. At the end of that time the headquarters and six companies were sent to Fort Lewis, Colorado, and three companies to Fort Lyons, Colorado, one company remaining at Santa Fé, New Mexico.

In October and November, 1882, the regiment was transferred to the Department of Dakota, headquarters, and Brinkerhoff's company, (A); Conrad's, (C); Stafford's, (D); and Bean's (H), took station at Fort Randall; Shorkley's (B) and McKibben's (I) at Pembina; Steelhammer's (G), and Hartz' (K) at Fort Lincoln; Humphreys' (E), and Whittemore's (F) at Fort Stevenson.

After serving in Dakota for about eight years, the regiment was directed to proceed to the Department of the East. Four companies got away in May, 1890, and proceeded to their new posts, A and G (Burnham) to Mount Vernon Barracks, Alabama, under command of Major Theaker; D, to Fort Barrancas, Florida, and K to Jackson Barracks, Louisiana.

In July, 1890, companies I and R were skeletonized under the provisions of General Orders 76, Adjutant-General's office of that year, and the men transferred to other companies.

The regimental headquarters and the five companies remaining in the

Department of Dakota were assigned for station at Fort Sheridan, Illinois, in the same month, and in August companies E and H proceeded to their new post under command of Captain McKibben. Lieutenant-Colonel O'Bierne arrived at Sheridan and succeeded to the command of the post on the 2d day of October following.

Owing to the incomplete condition of the officers' quarters and the barracks at Fort Sheridan, further movement of the regiment was suspended until January, 1891, when the headquarters proceeded to its new station. The companies in Dakota, and the companies serving in the South, followed in May.

Lieutenant-Colonel Samuel Owenshine joined on the 18th of March, 1891, by promotion from the Twenty-third Infantry, and Major Clarence M. Bailey on the 19th of August of the same year by promotion from the Eighth Infantry.

On the evening of the 29th day of September, 1869, the regiment appeared in line at Fort Selden, New Mexico, for the last time previous to a long separation of its companies. It assembled again in 1891, joining by detachments from the Dakotas, Alabama, and Louisiana, and on the evening of the 29th day of May, once more united in line, at Fort Sheridan.

"The Colonel congratulates the regiment," read the Adjutant in publishing the orders at the close of the parade, "that after twenty-one years it is again united. He is highly gratified at the soldierly appearance and good behavior of the companies recently joining headquarters. This indicates regimental pride and devotion to duty, which must produce good results. The present Colonel has served with the Fifteenth Infantry both in peace and in war, and knows there is no more gallant corps in the service. He is proud of his regiment and feels certain it will keep up, if not excel, its past record."

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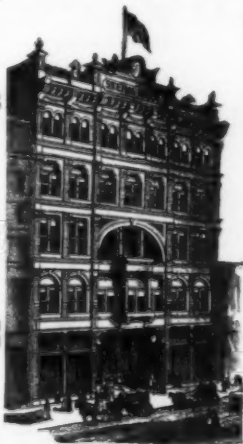
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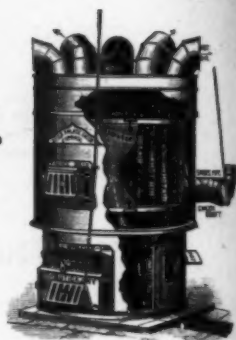


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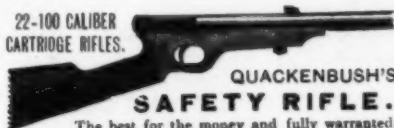


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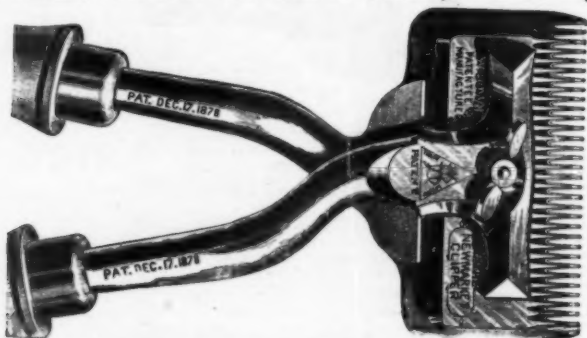
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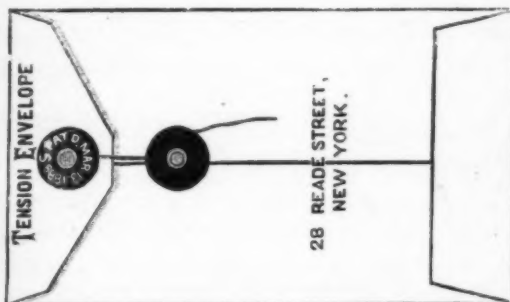
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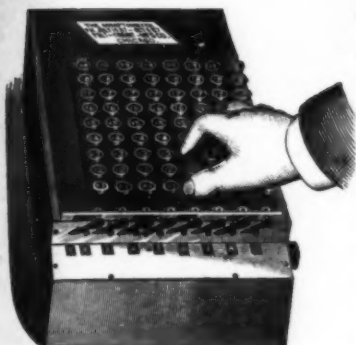
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